FLIGHT and The AIRCRAFT ENGINEER

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The Outlook

Long-range Fighters

FIRST official mention of long-range fighters in action was made in an Air Ministry Bulletin dealing with the recent daylight raid on Cologne. The types mentioned specifically were the Westland Whirlwind twin-engined fighter and the Supermarine long-range Spitfire.

Judging by the official account, the fighters do not appear to have been called upon to display any particularly long-range qualities, as it is stated that on the outward flight they met the bombers at the English coast and escorted them as far as Antwerp. When the bombers were returning, the long-range Spitfires met them again off the Dutch coast. The Whirlwinds do not appear to have met with any opposition, and their only victims were one barge sunk and another damaged by bullets. The Spitfires, on the other hand, had some encounters with the enemy, who had, by the time the bombers were on their way home, got some Messerschmitts and Ju 88s into the air. Several are thought to have been destroyed.

The significant thing about the raids is not the actual contribution of Fighter Command to the Cologne success of Bomber Command; this seems to have been small enough in all conscience. What *is* important is that the whole subject of escort fighters has been revived by the inauguration of daylight raids on Germany. If such raids are to be continued, escort fighters of much greater range than the long-range Spitfire can possibly have will be essential, for daylight bombing cannot for long be continued without fighter protection. What is the range of the Whirlwind has not been disclosed, and it does not, of course, follow that the distance from the English coast to Antwerp represents its maximum. As the bombers were flying low, they were fairly independent of fighter protection.

Whether, even with strong fighter escort, daylight bombing at really long ranges is possible without incurring prohibitive losses is open to debate. We proved last year, in the Battle of Britain, that our fighters could take such toll of German bombers and fighters that even the *Luftwaffe* could not keep up the daylight raids. But that does not necessarily prove that if the tables were turned the result would be the same. The Royal Air Force has established a superiority, man for man and machine for machine, which might upset any calculations based upon past experience.

Fortunately, it is comforting to know that if long-range fighters should be wanted in the future they will be forthcoming.

The American Air Question

WE learn from U.S. papers that, once again, there is keen discussion on whether the United States ought to institute a separate Air Force by combining into one Service the flying units of the Army and the Navy, as did Great Britain in 1918. One gathers from what one reads that, on the whole, the army airmen are inclined to favour such a step, while the naval airmen are against it. If so, that is also a reproduction of the general feelings in Britain in 1918.

It would be impertinent if *Flight* were to advise the United States on what would be best for her. Nevertheless it is our opinion that Great Britain made a mistake in 1918, not by forming the Royal Air Force,

but by omitting to leave the Navy and the Army with their own Air Arms when the independent Service was formed. After many years of acrimonious discussion, it was found necessary to restore the Fleet Air Arm to the Navy, while, at the present time, discussion is proceeding as to whether the Army ought not also to have its own air contingent.

Some people exclaim: "What, three Air Forces?" That expression is misleading. Britain needs one Air Force; *Air Arms* for the two senior Services are a different matter. Neither Air Arm (if both existed) in any way detracts from the need for maintaining the Royal Air Force. Only the R.A.F. could be entrusted, for example, with the air defence of Great Britain.

The Atfero Accident

JUST as we are about to go to press with this week's issue, news has come through of a second accident to an Atfero aircraft, and the Empire and the United States of America share the loss of another 22 men, bringing the total up to 44. Hitherto no official explanation has been given, and the only name of a victim of the second accident that has been published is that of Mr. Arthur Purvis, chairman of the British Supply Council in North America.

There is a similarity in the circumstances of the two mishaps which is rather disquieting. Both occurred shortly after the take-off, the first some distance away from the aerodrome, and the second just outside the aerodrome boundaries. The possibility that the aerodrome is unsuitable for the aircraft used cannot be ruled out.

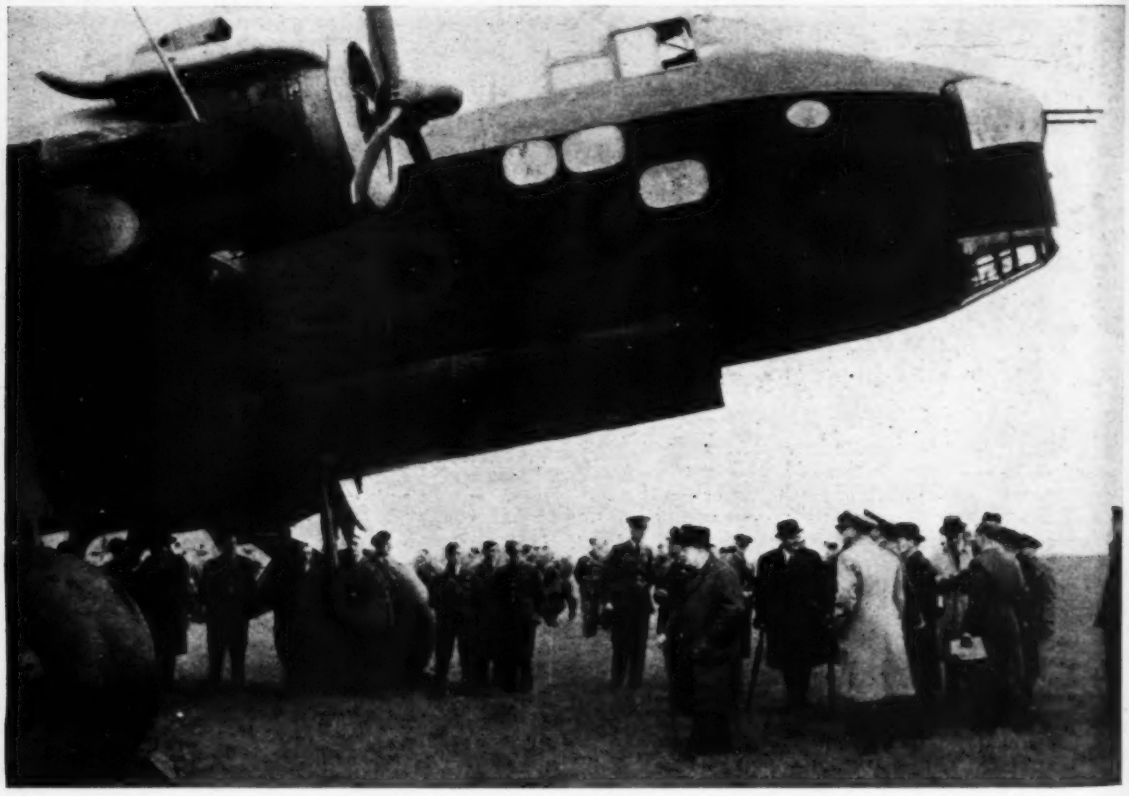
Technical Trends

TWO subjects are dealt with in the pages of this issue which are likely to occupy the thoughts of technicians in the near future: Contra-rotating airscrews and the vexed problem of fuel delivery to the engine. It is no mere coincidence that both relate directly or indirectly to high-altitude flying. The tendency in military aviation is in that direction, and that Power whose aircraft can attain the greatest height, coupled with speed and load-carrying capacity, will have a marked advantage over its opponents.

As an indication of this trend, we may mention that a high-flying Boeing Fortress was attacked by fighters recently and suffered damage and casualties, although it succeeded in returning home.

Among the advantages of contra-rotating airscrews is the extra efficiency which they give at great heights and high speeds. There seems to be little doubt that the Fortress would benefit from "contra-props."

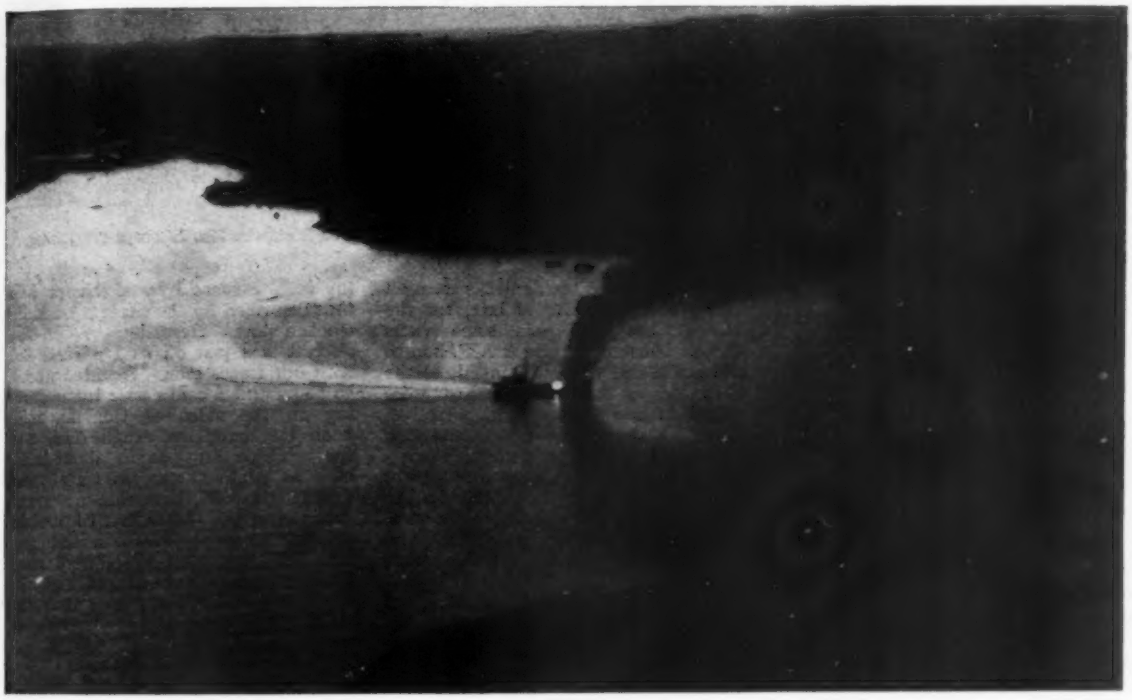
On the question of fuel delivery, a contributor to this issue gives what we regard as a very fair and unbiased estimate of the advantages and disadvantages of fuel injection. On balance, injection appears to score slightly, but it may well be that it would be impracticable to change over in the middle of a war such as that in which we are now engaged. Fortunately, there is in existence a well-tried system which appears to give most of the advantages of direct injection: continuous injection into the supercharger entry. Modification of engines for this system is far less drastic, and could probably be introduced without upsetting production seriously.



TO GIVE SHORT SHRIFT: Mr. Winston Churchill inspecting a Stirling four-engined heavy bomber. Stirlings, Halifaxes, and Manchesters are all being employed in the heavy raids on Germany.

War in the Air

R.A.F.'s Daylight Raiding : Danube Bridge Destroyed : Air Torpedoes Again



DAWN ATTACK : A German supply ship after being hit by a bomb from a Beaufort.

PLANNING a large-scale bombing attack involves a tremendous amount of accurate staff work. Air exercises in peacetime, and such events as the great review at Mildenhall held by the late King George V gave the various air staffs good practice in congregating squadrons and wings from various quarters, and bringing them over a given point at the right moment. The Hendon Displays were also good practice. When two Commands, Bomber and Fighter, have each to provide their quota, the staff work grows in complication.

In 1939 and 1940 comparatively little work of that sort had to be undertaken by the R.A.F. The Bomber Command was mainly concerned with night-bombing, while in the summer of 1940 the Fighter Command had to solve its own problems in dealing with daylight attacks by the *Luftwaffe*. Combined daylight raids are a development of the present summer. The strength of the Air Force has grown and is growing, and the scale of its daylight operations is accordingly increasing. Last week there was a very complicated series of operations in one day, followed by a series of night raids. Early in the morning six squadrons of Blenheims set out for Cologne to attack power stations, and they were escorted as far as Antwerp by two-engined Whirlwind fighters. Then the bombers went on alone over Holland, adopting the tactics of flying very low. When fast machines fly low, the A.A. gunners can hardly swing their sights on to them before the bombers have passed. The bombs were also dropped from a low altitude, and the crews said that it was impossible to miss the power stations. Over the targets the *flak* was intense, and one Blenheim, after dropping its load, went down into a quarry to escape from it, and for a while was flying about 30ft. below the level of the ground. Later the same machine chipped the tip of an airscrew blade against the top of a telegraph pole, and finally caught the tip of a wing in the top of a tree. On the return journey long-range Spitfires, not before mentioned in any official communiqué, flew out to meet the Blenheims at Antwerp, drove off some German fighters, and escorted the bombers home again. The Blenheims confessed that they were very glad to see the Spitfires.

On the same day there were raids by Fortresses over Germany and Holland, while Hampdens with a strong escort of fighters flew right into the Pas de Calais. The Fortresses flew so high that the crew of one saw German fighter trails thousands of feet below them as the defenders searched for the raiders. It was an impressive demonstration of the Air Force's ability to do what the *Luftwaffe* failed to do last summer, namely, to raid by daylight without suffering excessive casualties in machines. The following night the Bomber Command showed that its resources had not been exhausted by sending machines over Berlin and other places in Germany. It seems clear that everything went like clockwork, and the various air staffs concerned deserve high credit for their work. That the air crews deserve praise goes without saying.

The position in Russia may be changed from what it is at the moment of writing by the time these words are printed. It may be possible to deal with developments in stop-press style.

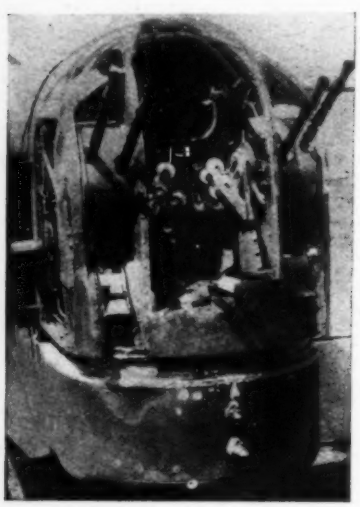
WAR IN THE AIR

But here it is a pleasure to record good work by the Red Air Fleet in destroying a bridge over the Danube in Rumania, 30 miles above the port of Constanza. The Soviet authorities gave the following account of the results of this piece of work. It is perhaps the most detailed and therefore the most useful statement issued by the Russians since the invasion of their country began. As a result of the destruction of this bridge, says the Russian statement, all military transport between Bucharest and Constanza has been stopped. The right bank of the Danube and the Black Sea coast are now isolated from the other parts of the country, and likely to remain so for some time. The oil stores at Constanza cannot be replenished because the old pipeline, which was laid along the bridge, was also destroyed. The Russian attack was carried out by bombers which in several waves approached the bridge at a great height. The anti-aircraft guns on the bridge blazed but they were silenced. Heavy bombs scored direct hits on the bridge, the 100ft. long span of which, completely destroyed, crashed into the river.

Syracuse Harbour

IT is also stated that the oil wells Ploesti in Rumania were burning three weeks after they were set alight by the Red bombers. Hitting the actual wells so as to set them on fire implies very accurate bomb-aiming.

In the Middle East Swordfish of the Fleet Air Arm flew into Syracuse harbour one night and launched torpedoes against a supply ship there. It is believed that two of the "tin-fish" scored hits. Something has been attracting particular attention to Syracuse harbour of late, for the R.A.F. has also paid some visits there. Presumably the R.A.F. bombs did not do all that was hoped, so the torpedoes of the Fleet Air Arm were called in and proved more effective. Enemy harbours in the Mediterranean must lead a somewhat anxious existence, especially since the Fleet bombarded Genoa. Presumably the enemy tries different harbours in turn, hoping to escape attention, and Syracuse has been one of the recent selections.



DANGEROUS CORNER: How a rear turret of a Whitley looked after a scrap with an Me 110 over Germany.

STAND FROM UNDER: The bomb-aimer of a Blenheim Mk. IV drops everything.

Cyprus comes in for an occasional raid. Last week a number of bombs were dropped by enemy aircraft in the neighbourhood of Nicosia and Famagusta, but no damage was done and nobody was hurt. If Syria were not now safely in Allied hands the position of Cyprus would be far more dangerous.

The Far East

THE Japanese Air Force bombed Chungking, the seat of Chiang Kai Shek's Government, for four days and nights continuously, and then after a short pause began again. The damage done was great, and there must have been large numbers killed and wounded. The Japanese are also using their bases in Indo-China to bomb towns in the Chinese province of Yunnan. Thailand in Japanese hands would be a serious menace to Allied possessions, and the Burma road would become an easier target. Hitherto their bombers have failed to close that road.

The gunners on a number of our small ships are developing into fine marksmen. It will be remembered that before the war the Navy held classes to train officers and men of the Merchant Navy in meeting air attack as well as submarine attack by gunfire. This was doubtless very useful, and since the war broke out many of the gunners have had to use their weapons in defence of their vessels. Among many incidents of the sort, a success by a coaster was thus described by the captain when he reached port. He said: "When the aircraft was just on us I opened fire with our Lewis gun. We fired about 50 shots and I could hear them pinging on the sides of the machine. Soon the aeroplane caught fire, and the machine dropped to about 20ft. off the water, rose a little, and dropped to 10ft., then rose again and dropped to 5ft. After that I lost sight of him. Three Spitfires went out after him. They circled round and then back as if they had finished with the enemy. I heard next day that the German had been seen in the water."

Resource

BUT if merchantmen often defeat enemy aircraft, British airmen at times get the better of much more formidable surface craft. One day not long ago a Hurricane was on patrol near Malta when the pilot saw an E-boat approaching the island. He went down low and attacked it, but the E-boat's guns damaged the Hurricane. The pilot got in a burst which wiped out the gun crew. Others of the crew ran to take their places, but the pilot, although his aircraft was almost uncontrollable, swept them with bullets as well. His machine then pancaked on to the sea, and the pilot climbed out. He swam a short distance to the E-boat, and hauled himself aboard. All the members of the E-boat's crew were either dead or wounded, so the pilot took possession and eventually brought his capture into Malta Harbour.

The number of Polish squadrons in the R.A.F. is on the increase. Three Polish fighter squadrons are now able to work as a Wing, although none of the three had reached the stage of being operational before this year. To become operational means that a squadron has been trained up to the point where it is considered competent to engage the enemy, either with machine gun or with bomb, according to whether it is a fighter or bomber

ENEMY AIR LOSSES TO AUGUST 16th.

	Over G.B.	Over Continent	Middle East
Aug. 10	—	1	1
,, 11	—	—	5
,, 12	—	4	—
,, 13	—	—	—
,, 14	—	14	—
,, 15	—	—	—
,, 16	1	1	—
	1	20	6

Totals: Northern Area, 5,221; Middle East, over 2,053.

unit. This Wing does not include the first two squadrons of Poles which were in action last year. The first of them shot down more than 120 enemy aircraft in 1940, and the second squadron also distinguished itself. Last week the Polish Wing went out over Northern France one afternoon and met a large force of German fighters. The Poles bagged 13 of the enemy for a loss of three Spitfires. Since joining the R.A.F., the Poles have destroyed over 250 German machines. A second Eagle squadron of American pilots has also been formed.

Among recent achievements by the R.A.F in the Middle East has been the successful blocking of the Corinth Canal. The ideal way of blocking a canal is to sink a ship in it. Our

WAR IN THE AIR

bombers were not lucky enough to do that, but they brought down so much of the embankment into the canal that it will not be possible for ships to get through for some time to come. This will be a grave inconvenience to enemy shipping between the Ionian Sea and the Ægean.

Tankers Torpedoed

THE Middle East has been very busy in the last week or so, and again the Fleet Air Arm has scored with its torpedoes. One convoy of five merchant ships and a destroyer was attacked, and it is practically certain that two of the merchantmen and the destroyer were sunk. On the same day two tankers and two schooners were attacked with bombs by R.A.F. Blenheims in the Central Mediterranean between Tripoli and Benghazi. All four were hit, and one tanker blew up at once, while the other was set on fire. Both were probably sunk.

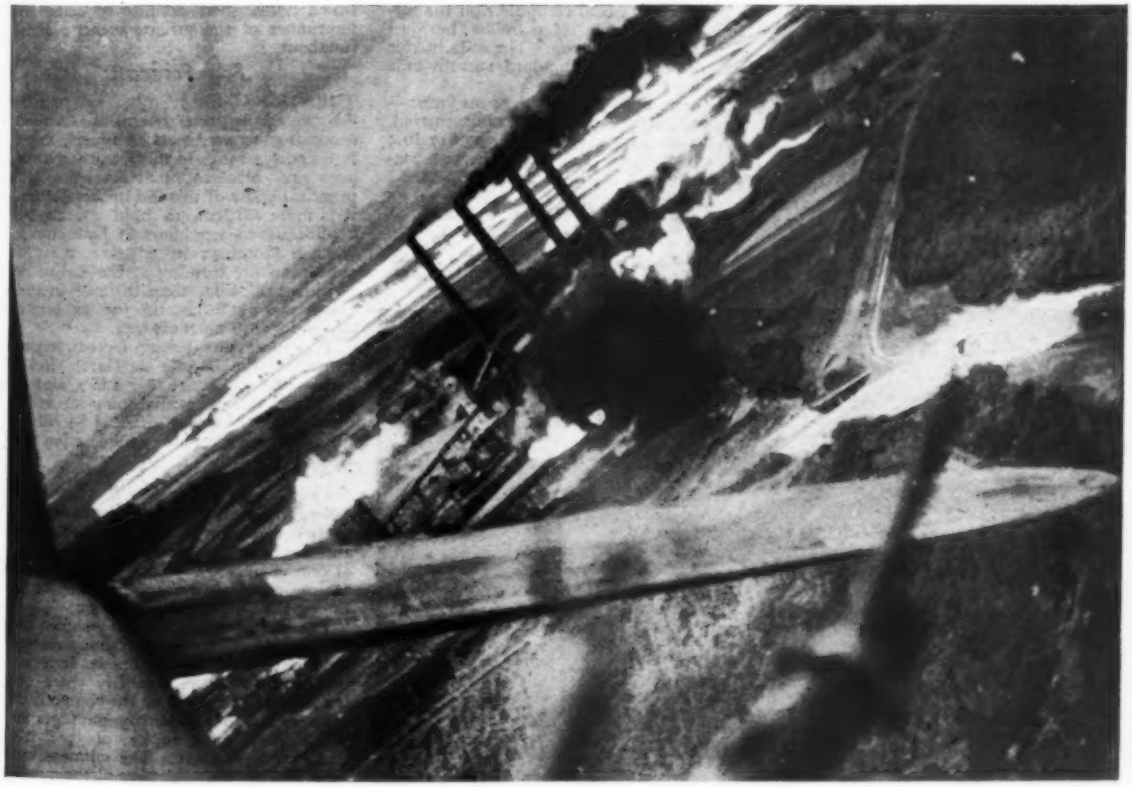
The Russians have mentioned the use of six-engined bombers in recent communiqués. Probably they were converted passenger machines of the type 760. An illustration of the type appeared in *Flight* of Dec. 12th, 1941.

BRITISH AIR LOSSES TO AUGUST 16th.

	Over G.B. Fighters	Over G.B. Pilots	Over Continent Aircraft	Middle East Aircraft
Aug. 10	—	—	3	—
,, 11	—	—	—	1
,, 12	—	—	33	—
,, 13	—	—	—	—
,, 14	—	—	18	3
,, 15	—	—	—	1
,, 16	—	—	13	—
	0	0	67	5

Totals: Northern Area, 2,492; Middle East about 357.

Sir Archibald Sinclair, Air Minister, has spent a night with units of the Bomber Command, visiting stations whence Stirling and Wellington bombers set out on their nightly business. He made a speech to some of the crews, telling them that "It is the Bomber Command which is going to be the main instrument of victory. It is the fighters who saved us from defeat last autumn, and it is the bombers who are going to smash the war industries of Germany and break the will to win of the German people." Words like these must have a very stimulating effect on crews who are just about to set off on a daring raid, and will make all their troubles, efforts, and risks seem small in comparison with the results which they hope to achieve.



DAYLIGHT ATTACK: With tail and target, shell and bomb bursts, all at crazy angles, this vivid photograph of the Blenheim attack on the power stations of Cologne gives anyone who has flown an exact picture of the raid. The "g" can be positively felt.
A second picture appears on page 105.

HERE AND THERE

Bristol Benevolence

AMONG recent contributions to the Royal Air Force Benevolent Fund is one of £10,000 from the Bristol Aeroplane Company, Ltd.

The Lockheed Lightning

THE American periodical, *Life*, describes the Lockheed P-38 Lightning as having five guns topped by a 37-mm. shell gun. Rate of production is said to be one per day. The U.S. Army Air Corps ordered one of these fighters in 1937; it was tested in the early part of 1939 and an order for 67 placed. The first of this order was delivered in September, 1940, and the last is due this month. Work on an order for 460 will then commence.

New Zealand Manufacture

THE De Havilland factory at Rongotai Aerodrome, Wellington, is busy turning out Tiger Moths for the Royal New Zealand Air Force and the Empire Air Training Scheme. The company were fortunate in establishing their factory, with Mr. Hugh Buckingham as manager, just before the war started. Since then nearly 200 aeroplanes have been made. Lately the manufacture of wooden airscrews has commenced, and components for the R.N.Z.A.F. Airspeed Oxfords are being made also.

Trans-Tasman

FIGURES for the year ended March 31st show that New Zealand and Australia have good cause to be proud of the record achieved by Tasman Empire Airways. Of 134 trips scheduled 130 were completed—97.01 per cent. of the possible—an exceptionally high proportion for ocean crossings over a period of twelve months.

All the trips were made by the *Aotearoa* and *Awarua*, which carried a total of 1,461 passengers (an average of over eleven per trip. The hours flown amounted to 1,180.48, an average of 9.08 hours per trip. The quickest flight was 6 hr. 57 min. on March 23rd. The aggregate of miles flown was 174,200, computed on the airline distance of 1,340 miles between Auckland and Sydney. The mile in this calculation is the standard statute mile (1,760 yards).

Other figures for the year are:—Freight carried, 14,448 lb.; mails carried, 77,571 lb.; baggage carried, 33,817 lb.; passenger-miles, 1,957,740; freight ton-miles, 8,644; mail ton-miles, 46,402.

THE FLYING WING AGAIN: Recently ferried for special duty to French Equatorial Africa by Mr. James Mollison, the Cunliffe Owen Flying Wing is once more in the news. This design was developed in U.S.A. by Burnelli and taken up here by the Cunliffe Owen factory before the war.

Sikorsky Predicts Giants

IGOR SIKORSKY predicted to the American Society of Tool Engineers recently that the aircraft of the future, the future measured in decades rather than centuries, would probably not fly faster nor much higher than the aeroplane of to-day, reports *Aero Digest*. But it will be much larger and may weigh as much as 1,000 tons and carry several hundred persons. Sikorsky also predicted that the number of helicopters would exceed the number of military and commercial aircraft combined. This recalls his recent record-breaking flight in his own design, the VS300, a design which holds great promise of being the forerunner of the private owner's aerial runabout.

Fog Forecast

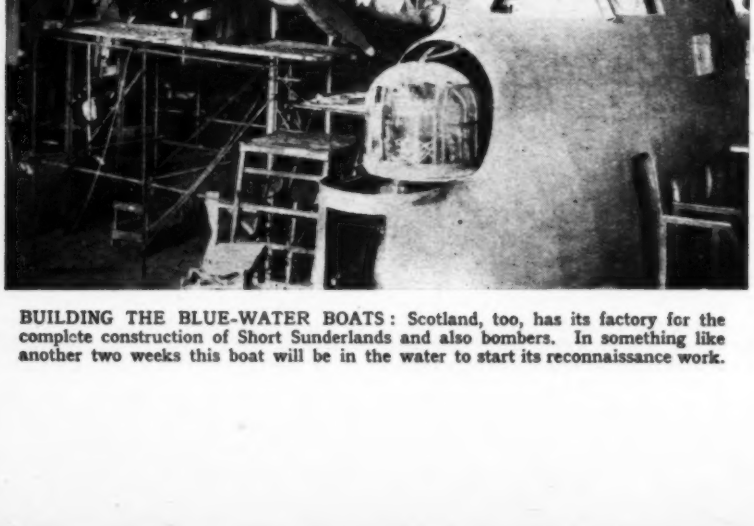
RESEARCH work by a 26-year-old meteorologist at Miami has resulted, according to an American report, in the forecasting of fogs in this locality with an accuracy hitherto unattainable. The practical value of this lies in the fact that it is more efficient to hold southbound air-liners for a few hours at Jacksonville, when it is known in advance that fog conditions are forming at the end of the Florida peninsula, than to have to turn them back again because fog has formed while they are on their way.

The successful young meteorologist's name is John Randle de Hart, who is employed by Eastern Air Lines and his achievement has gained him an award which includes a cash prize of $500 from the Air Transport Association of America.

Spotters' Cup

IN appreciation of the close co-operation between the Royal Observer Corps and the Royal Air Force, the commander of one of our heavy bomber squadrons has presented a silver cup for competition among the Corps near his station.

The first competition has shown the remarkable standard of accuracy reached by these men who, in lonely outposts, spot enemy raiders, identify them and send out warnings. For the competition, each post had to identify photographs, taken from queer angles, of 37 British and enemy aircraft. The winners were a post of 20 men; only five of them made any mistake at all, and they made only one mistake. They identified one aircraft as a Blenheim without saying that it was a Blenheim IV!



BUILDING THE BLUE-WATER BOATS: Scotland, too, has its factory for the complete construction of Short Sunderlands and also bombers. In something like another two weeks this boat will be in the water to start its reconnaissance work.

Thirty-third of the Series

FRIEND or FOE?

Two Naval Catapult Aircraft : Vickers Walrus and Meridionali RO.43

Vickers Walrus : Biplane amphibian ; backswept parallel wings of equal span ; no stagger, single bay. One radial engine mounted between the planes in streamlined nacelle, pusher airscrew. Single-step hull with gun positions in nose and amidships. Fixed wing-tip floats, undercarriage retracts into lower wing. Combined tail-skid and sea-rudder. Strut-braced rectangular tail-plane high on tail-fin.

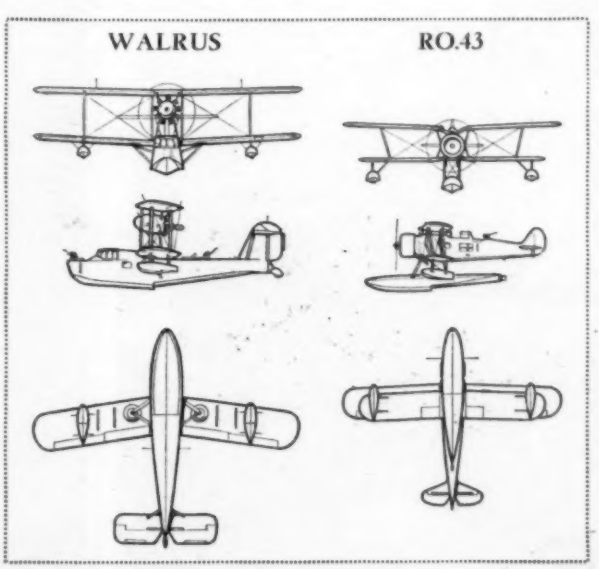
Meridionali RO.43 : Single-float biplane with fixed wing-tip floats. Top wing gulled and of greater span and chord than lower wing. Slight stagger and backsweep ; single bay, parallel edges. Two fixed forward guns and one free gun in aft cockpit. Rather small, rounded fin and rudder ; strut-braced tailplane with backswept leading-edge and rounded tips and elevators.

ALTHOUGH the Italian Meridionali RO.43 is not, perhaps, among the really familiar types of aircraft, it is nevertheless an opposite number of the familiar Walrus from the operational viewpoint, being the standard shipboard reconnaissance type of the Duce's navy—a part of which, we understand, is still floating.

The Vickers Supermarine Walrus was originally designed as a fleet spotter for the Australian Navy, to whom it is known as Seagull V. It was adopted by the British Admiralty in 1935 for the Fleet Air Arm and, even to-day, is regarded with affection by its pilots and crews, who appreciate its sturdy reliability.

It is, of course, one of the very easiest aircraft to recognise in flight, being the only biplane amphibian with a single pusher airscrew. Its backswept wings with parallel edges and rounded tips are identical in plan, and its Bristol radial engine is mounted between the centre-section planes in a streamlined nacelle. As the wings fold for easy stowage aboard ship they are fitted with jury struts, and these can either be removed or left in position during flight ; as speed is leisurely by modern standards there is not much to be gained by their removal. Fixed, wire-braced floats are mounted immediately below the inter-plane struts of the single-bay wings and the undercarriage, comprising oleo legs with radius arms, folds outwards, lifting the wheels into recesses beneath the lower wings. The single-step hull projects well ahead of the wings and has a gunner's cockpit right in the prow, and an enclosed cabin for the pilot and navigator in front of the leading-edge. An open cockpit behind the wings mounts additional armament. The tail assembly is also distinctive. Fin and rudder are large and have a broad, rounded apex, and immediately beneath the projecting trailing-edge of the rudder is a combined tail-skid and sea-rudder. The tailplane, which is approximately rectangular, is mounted exceptionally high on the fin and is externally braced with double struts. A "bite" in the trailing-edge of the elevators allows for normal rudder movement.

The wings of the RO.43 are of the single-bay type, the upper pair being of greater span and chord than the lower ones. They are very slightly backswept and have a small degree of stagger, the inter-plane struts also sloping outwards at the top. An unusual feature of the top wing is that the centre-section dips sharply down to meet the fuselage, giving a gulled effect, and the pilot looks directly forward through the V so formed. The fuselage, mounting a radial engine on the nose, has two tandem cockpits, and the tail unit is of normal design. Fin and rudder are rather small with a nicely rounded apex and trailing-edge, and the strut-braced tailplane has a pronounced backsweep to the leading-edge and rounded tips ; the elevators have a "bite" for rudder clearance at the trailing-edge.



Next week begins a new phase of "Friend or Foe?" which will deal mainly with tail design.

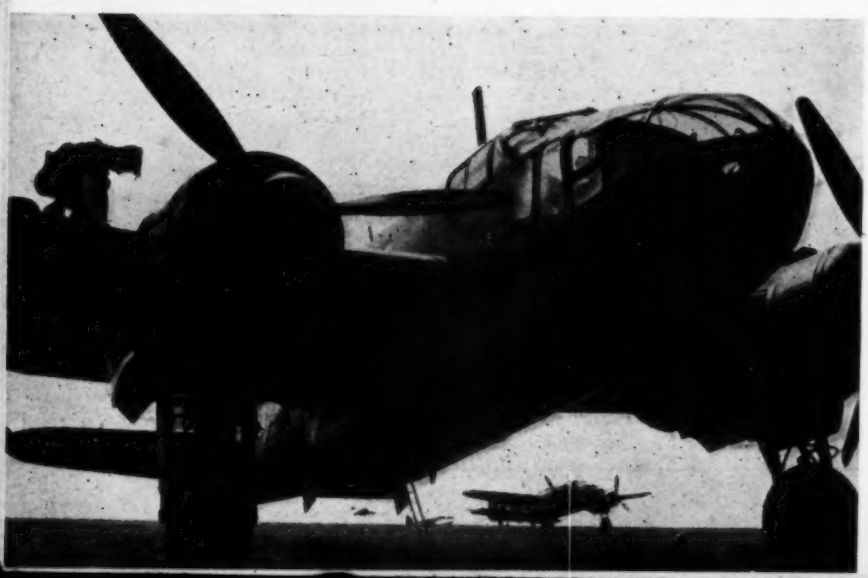
COASTAL

Photog *he*

Fight the Atlanti ***a***

IN the *centre above* is a head-on shot of a Consolidated Catalina —the type which found the *Bismarck* after it had eluded our surface vessels. Under its wings are hung four anti-submarine bombs. The *top left* photograph shows a Lockheed Hudson to advantage. The projections at the trailing-edges are guides for the Fowler flaps. *Left centre* is a wireless operator with one of the homing pigeons which are always carried in case of a forced landing—one of the oldest forms of communication comes into its own if the most modern variety breaks down. *Bottom left* is a Bristol Beaufort complete with backward-firing under-turret and semi-submerged torpedo ready to deal with enemy shipping.

The *main centre* picture is that



AL

COMMAND

Photog[raphs] of the Men and Machines that [guard] the Atlantic and Search the Narrow Seas

seen by the rear gunner of a Short Sunderland as he looks forward toward the nose. On the top storey are the two 'midships air gunners with their gas-operated Vickers K guns, and on the lower deck the crew's quarters. On the same floor are kitchen and ward room.

Coastwise convoys liable to attack by the *Luftwaffe* bombers are under the protection of the Hurricanes seen in the *top right-hand* photograph. *Centre right* shows a bomb train being loaded up at a Coastal Command aerodrome bomb store, and—*bottom right*—a Catalina crew, complete with provisions, leave their Nissen hut for their aircraft. Patrols sometimes last for more than twenty hours.

READY for the FUTURE

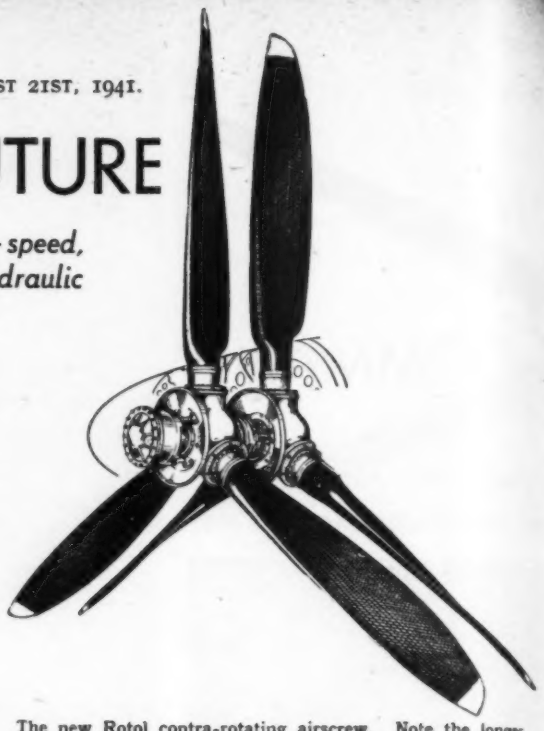
Rotol Adds a Contra-rotating, Constant-speed, Feathering Airscrew to Its Range : Hydraulic Operation : Wood or Metal Blades

DURING the early days of flying, discussions concerning the merits of and need for variable-pitch airscrews were frequent, long, and often heated. This much will have been gathered from the article in last week's issue. The truth of the matter is, of course, that both sides were right; it all depended upon the period in which protagonists and antagonists lived. At the time when the discussions started, the types of aircraft in use would not, generally speaking, have justified the weight and expense of V.P. airscrews, and to that extent the critics were right. On the other hand, those who looked farther ahead were correct in *their* claims that types of aircraft would be developed in which the V.P. airscrew would be not only worth while but an essential part of the aircraft if this was to perform its functions with a maximum of operational efficiency.

The wheel has now completed a full circle, and we are debating the merits of contra-rotating airscrews. In the issue of *Flight* dated April 17th, 1941, we commented in a leader on the problem of converting efficiently into thrust the 2,000 h.p. or so of the new British engines, and suggested that the time had come when coaxial oppositely rotating airscrews should be put in hand We reminded our readers that one British firm had begun development several years before, and that thus there was no need to go abroad for ideas.

It has now become possible to reveal that another British firm has entered the field, and that a six-bladed, constant-speed, feathering airscrew, hydraulically operated, is in existence, although it has not yet gone into service. This is due to the fact that at the moment the majority of aircraft types in use in the R.A.F. are not in urgent need of the special advantages which the contra-rotating airscrew has to offer. Thus we are back once more at the stage when it is possible to argue both for and against the adoption of a new type of airscrew; it would be well not to permit history to repeat itself by delaying the development of "contra-props."

Readers of *Flight* who studied the article in last week's issue will be familiar with the history of the Hele-Shaw-Beacham V.P. airscrew, and how it has ultimately become the Rotol. (The name, by the way, is compounded of the first and last letters of the names Rolls and Bristol.) Here we may recall the types of Rotol V.P. airscrews already in service with the R.A.F.



The new Rotol contra-rotating airscrew. Note the longer roots on the rear blades, which accommodate the spinner.

First, there is the type with limited pitch range (20 deg.). This has an internal cylinder and is the simplest of the range; it is suitable for trainers which only require a moderate range of blade travel. Then there is the 35-deg. type with external cylinder suitable for fast single-engined types of aircraft. Both these are of the constant-speed type, with a governor controlling the speed and keeping it at the figure selected by the pilot.

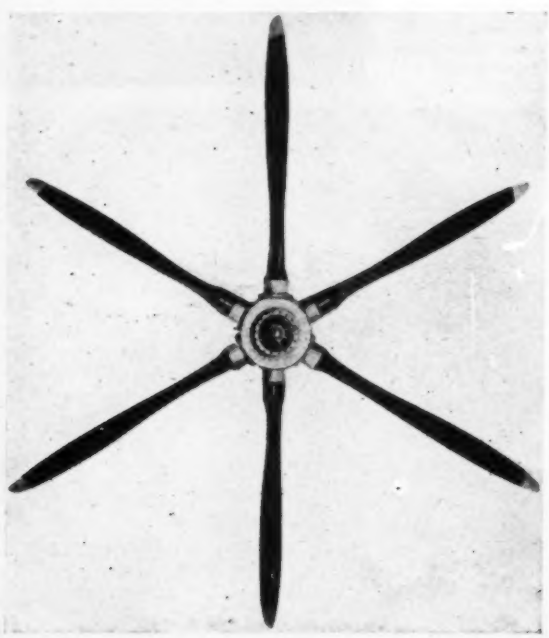
Feathering

For twin-engined aircraft a feathering airscrew is an advantage in that if an engine is damaged it can be stopped by turning the airscrew blades "edge-on" to the wind This type has a pitch range of 75 deg., the full range of 90 deg. rarely being required, although it could be provided if called for.

The three types mentioned above are all hydraulically operated. In addition to them there is an electrically operated type which also possesses the constant-speed feature. The versatility of the range will be appreciated when we mention that, with the exception of the 20-deg. type, all are available in three-blade and four-blade form, and with wood or metal blades.

Completing the range, the new contra-rotating airscrew is virtually two feathering types placed coaxially, and driven in opposite directions by appropriate gearing. The hydraulic mechanism is identical with that used in the single three- or four-bladers, and the fore-and-aft spacing of the two screws is a little over one foot, it being considered that this spacing will form a good compromise between the avoidance of flutter, which might result if the blades were very close together, and the ability of the rear airscrew to "take the twist out of" the slipstream of the front one.

Owing to the fact that the rear airscrew of the combination is dealing with air already set in motion by the front one, the pitch setting is slightly coarser. In the Rotol contra-prop. this difference in pitch angle is selected from considerations of the type of aircraft to which the airscrew is fitted, and remains constant over the entire



Feathered: The Rotol contra-prop. with its blades turned "edge-on" to the direction of flight. The rear blades are set at a slightly coarser angle than the front ones.

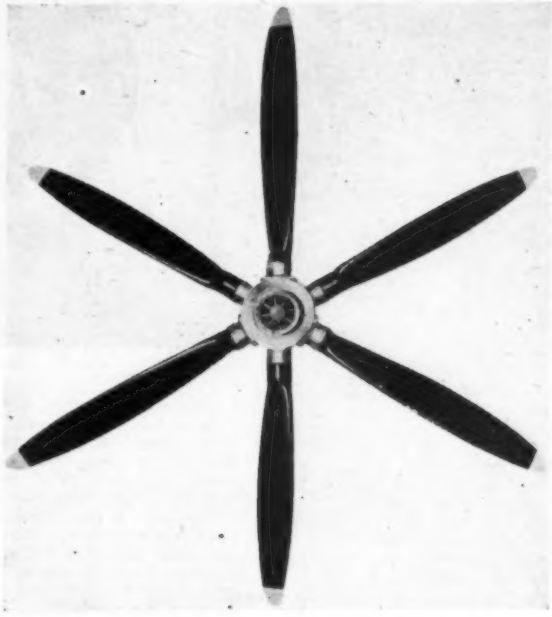
READY FOR THE FUTURE

range from fine pitch to feathered position. As in the single airscrew, the pilot selects his engine speed, and the governor maintains this under all conditions by increasing or decreasing the pitch, thus keeping the load on the airscrew constant.

Mention has been made of the fact that the contra-prop. is not "worth while" on all types of aircraft. This requires some little explanation. In transforming engine horse-power into thrust there are two limiting factors: engine speed and the speed of the tips of the airscrew blades. The first of these two is fairly obvious—the engine is designed to run at a certain maximum speed for long periods; if that speed is exceeded, the life of the engine will be shortened, and the engine may even be wrecked. The second is not quite so obvious.

The speed of sound in air is just over 1,100ft./sec. at ground level. If the airscrew tips reach this speed, or even if they approach it, a change in airflow takes place, and the airscrew thrust suffers a serious drop. By interposing gearing between the engine and the airscrew, the tip speed can be kept down, but a limit to this is set by the fact that maximum airscrew efficiency depends, among other things, on the ratio of pitch to diameter, and as the slow-running airscrew has to have a coarser pitch than a fast-running, for a given aircraft speed, one soon reaches this limit.

In addition to these considerations, the unfortunate airscrew designer is faced with many other problems. For instance, he is being asked to convert into useful thrust, with a maximum of efficiency, greater and greater horse-powers. To absorb these high powers he can increase the size, i.e., diameter, of the airscrew, but he then runs into the problem of tip speeds. He can increase the blade width, but here again he cannot go beyond certain limits without incurring a loss of efficiency. Our old friend aspect ratio, well known from the aerodynamic design of aircraft wings, comes into the picture and may not be reduced beyond certain proportions.



In fine pitch: This picture of the Rotol contra-prop. should be compared with that on the preceding page The pitch angle range is 75 deg.

Helix Speed

While aeroplanes were slow, and the airscrews were ungeared (i.e., were running at engine speeds), these problems were comparatively simple. Now, however, with aircraft reaching or exceeding 400 m.p.h., they are increasing by leaps and bounds. It is not always remembered that the tip of an airscrew blade travels through space in a spiral path, compounded of the forward speed of the aircraft and the rotational speed of the airscrew. It will be obvious, when this fact is recalled, that the airscrew tip travels a greater distance in a revolution than does the aircraft, so that the *local* speed of the tip is much greater, and the speed of sound is reached locally much earlier than at other parts.

It might have been thought that this list of limitations would exhaust the subject. Unfortunately this is far from being the case. The poor airscrew designer has yet another aspect to take into account. Hitherto we have considered low-altitude flying only. The tendency of modern military aircraft is to fly higher and ever higher. At 20,000ft., which is a moderate height nowadays, the air density is less than half of the density at ground level. It is an unfortunate fact, from the airscrew designer's point of view, that the speed of sound decreases in proportion as the density decreases. Thus, a tip speed which might be permissible at low levels would be excessive at 30,000ft., for example, and once again a compromise has to be sought.

Reference has been made to the subterfuge of increasing the blade width, and the limited extent to which the power can be efficiently absorbed in that way. An obvious alternative is to increase the number of blades. But although four is a workable compromise, a greater number introduces interference effects. The easiest way to picture these is, perhaps, to think of biplane, triplane and multiplane wing arrangements. The monoplane is the most efficient, then the biplane, and the triplane begins to be somewhat inefficient, although it does give extra lift. So with the number of airscrew blades. Single-bladed airscrews are in existence, and are efficient. The two-bladed airscrew so common a few years ago represented the biplane, the three-bladers now in common use the triplane, and it is fairly efficient. But a greater number than three begins to be inefficient, although four-bladers are used effectively on certain types in which airscrew diameter is limited.

Straightening the Slipstream

Airscrew efficiency pure and simple is but one aspect. A single airscrew sends a spiral slipstream back over the aircraft. This causes unsymmetrical airflow and thus a tendency for the aircraft to "swing," as it is termed; that is to say, to swerve to one side. This tendency is always present, but is worst when the amount of slip is greatest, such as, for instance, during take-off. Now, obviously, an aircraft designed to fly fast at 30,000ft. or even higher will have an airscrew of fairly coarse pitch, and this will give a high degree of slip at low forward speeds. Consequently, the tendency of such an aircraft to swing will be more pronounced than that of one which is designed to operate at low heights and moderate speeds.

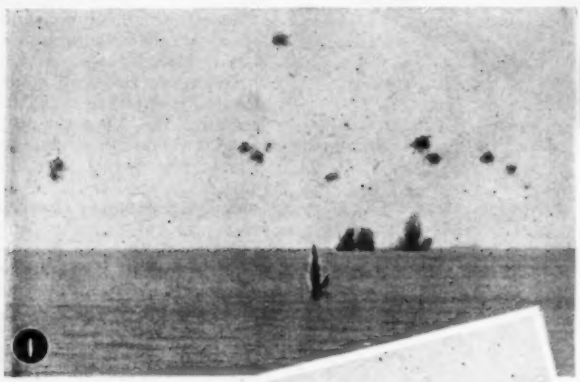
Over and above the troubles caused by the twist in the slipstream there is the torque reaction. This has to be opposed by "rigging down" the ailerons on one side, or in some similar way. Evidently such rigging cannot exactly balance torque except at one engine speed; at others there is a residual torque which is not corrected. As engine powers go up so does torque reaction increase. On some aircraft types this is not very important, but on others it can cause much trouble to the pilot. Deck-landing aircraft, for example, have very little room for swinging.

Quite obviously, therefore, there is much to be said for an airscrew system which does away at one and the same time with the twisted slipstream and with torque reaction, in addition to absorbing with good efficiency at great heights the power of the latest high power engines in fast-flying aircraft. It is for such that the contra-prop is specifically intended, although its application to more "modest" types for certain work is also worth while.

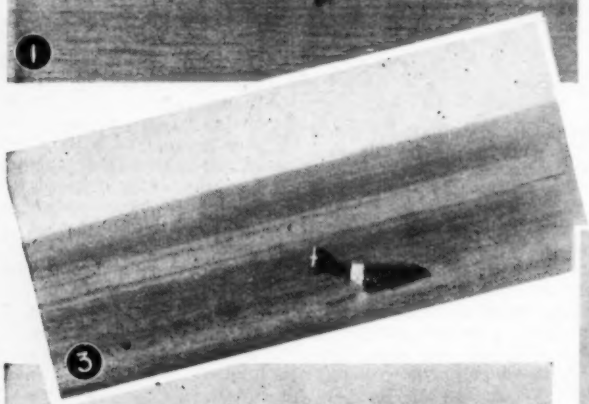
CONVOY BATTLE

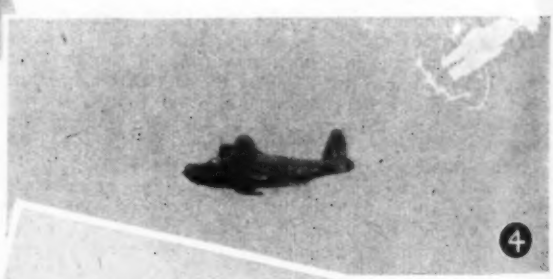
Scenes from the Two-day Attack by Enemy Aircraft, E-boats and Submarines on a British Convoy in the Mediterranean

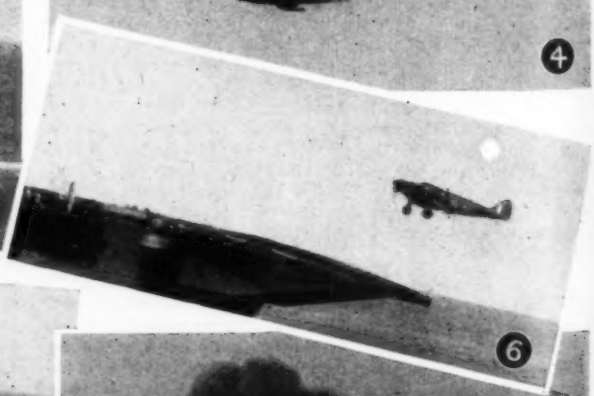
British Newsreel Photograph



1. Umbrella barrage of A.A. shells bursting in the air and a stick of bombs in the sea. The splash in the foreground is from a shell hitting the water. 2. A steel-helmeted signaller sends the message "The convoy must go through." 3. A Savoia Marchetti 79 in the water after being shot down. 4. A Sunderland flying boat from one of our bases passes over the convoy 5. An unfortunate Fairey Fulmar at the moment of a forced landing on the sea. It has skidded along the water from the right and finally turned completely round before digging its nose in. 6. A Fairey Fulmar coming in to alight over the aft "round-down" of H.M.S. *Ark Royal*. 7. In the foreground is a ship's multiple pom-pom at the ready. In the middle distance the attendant destroyer of the aircraft carrier H.M.S. *Ark Royal*, which is seen in the distance. 8. H.M.S. *Fearless* on fire after receiving a direct hit. This was our only loss in an air/sea battle which lasted for two days.



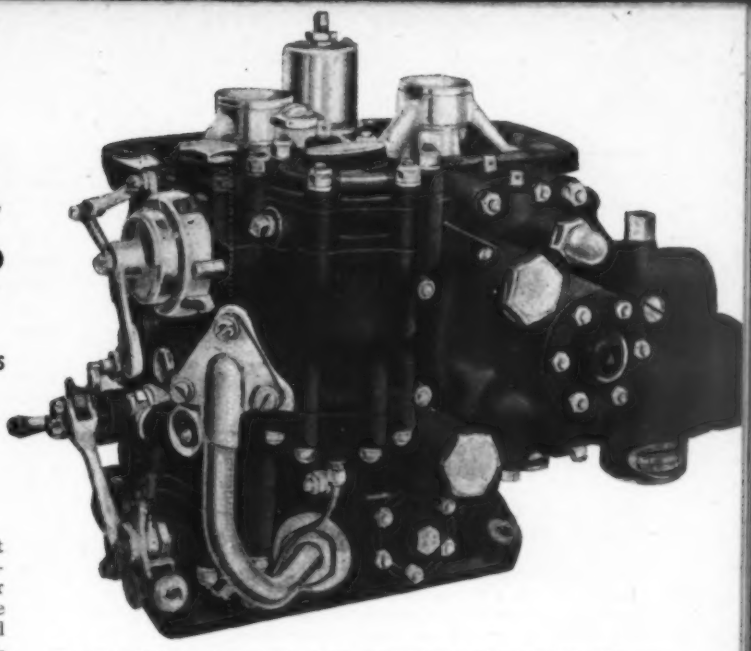




CARBURETTOR, INJECTION, Or —?

A Comparison of the Different Systems of Supplying Fuel to Aero Engines

By CHARLES H. FISHER, A.M.I.Mech.E., M.I.A.E.



The Bendix-Stromberg unit gives continuous injection into the entry of the supercharger.

THERE has been much discussion during recent times concerning the respective merits of conventional carburation versus direct cylinder injection in connection with aircraft engines. The fact that the Germans have gone the whole hog and standardised cylinder injection on all German aircraft-of-war has led many to question whether the British policy of adhering to orthodox carburation is the correct one. "Surely," they say, "the Germans are clever engineers; they would not go to all this trouble unless the results were worth while?"

Are the results worth while? The question is not an easy one to answer. We can say, however, that, so far as can be ascertained at the moment, the results do not appear to be worth the extra complication and cost. This is not to deny satisfactory development in the future, nor to deny certain obvious and fundamental advantages that should accompany fuel injection. Some of these advantages are inherent in the system, and will necessarily be present; but, bearing in mind also the fact that since the war began the Germans have found it necessary to make considerable modifications to their design, the issue is by no means clear. Why the Germans have found it necessary to employ such high injection pressures we do not know, but it is confirmed that the peak injection pressures now exceed two tons per sq. in.

Rolls-Royce versus Junkers Jumo

Some criticism has been levelled against the article published in *Flight* some time ago, which described comparative tests of the Rolls-Royce Merlin and the German Junkers Jumo engines. While most engineers will agree that comparative tests of two different types of engine, each with a different form of fuel delivery system (such as were employed in these experiments) is unlikely to produce strictly comparative results as to the relative efficiency of the said systems, the test was doubtless the only one of its kind possible at the moment.

It will be agreed that, in order to obtain a true comparison of two such fuel systems, it would be necessary to convert the Merlin engine to direct cylinder injection and the Jumo to Merlin carburation; and to take exhaustive tests at sea level and at altitude on both engines before and after conversion. This would entail many months of extremely costly work, engaging the time of highly skilled men who can ill be spared during these vital times. It must be borne in mind also that an enormous amount of research work has already been carried out on cylinder injection both in this country and in the United States, and the Merlin-Jumo tests must not be regarded as the only available basis for judgment. In addition, the article referred to made several shrewd points against cylinder injection, not the least important of which was the comparison of weights and complication, and the rapid increase of these factors with increase in number of cylinders.

Pro and Con

Let us examine the subject of orthodox carburation versus cylinder injection in greater detail. Owing to the exigencies of wartime conditions and censorship generally, it is impossible to approach the matter in a comprehensive manner, and it will be understood that there are a great number of data which cannot be quoted. The information available, however, makes an interesting story.

Chief Advantages and Disadvantages of Cylinder Injection as Against Conventional Carburation.

For	*Against*
(1) Completely non-icing.	(a) Greatly added complication of carburation assembly.
(2) Metering undisturbed by position of carburation system or manœuvres of the aircraft.	(b) Greatly added weight, unit for unit.
(3) Freedom from vapour lock at high altitudes.	(c) Weight increases rapidly with increase in number of cylinders.
(4) Better distribution of fuel.	(d) Loss of pressure ratio at supercharger through absence of fuel.
(5) Elimination of pressure loss at carburettor (which is more than counterbalanced by (d) in opposite column).	(e) Fuel infiltration of extreme importance.
(6) Better scavenging owing to little or no limitation on valve overlap?	(f) Control of mixture ratio complicated.
(7) Designed for use with inferior fuels?	(g) Rotational speed of engine limited by injection system?
	(h) Maintenance costs increased?

The table lists the chief pros and cons in the general order of importance. The final items followed by a query indicate those factors upon which we have no reliable data. Certain claims on one side will be counterbalanced by others in the opposite column; such as (5) on the left being outweighed by (d) on the right, and (4) by (f). From the operative aspect the first three items in the left-hand column are, of course, the most important of all. (It should be noted that all fuel injection systems of the three known types described hereafter possess these three paramount characteristics.)

A study of the table with its varying factors of advantage and disadvantage will lead the student to wonder whether it is not possible to design a system in which the advantages of both conventional carburettor and cylinder injection are combined to the common good. This is indeed approached in the arrangement of continuous spray injection, developed by the Bendix-Stromberg concern of America.

Other Fuel Injection Systems

So far we have dealt only with direct injection into the cylinder head (as used on the German engines), chiefly because it is around this design that most discussion has raged. In order, however, to obtain a true picture of the possibilities of fuel injection in general, we must go further, for there are other forms which demand our attention.

Up to the present time, the types of fuel injection systems which have been developed or partly developed for use with spark-ignition petrol engines for aircraft are broadly limited to three. These are as follows:—

(x) *Timed Injection into the Cylinder Head.*—This system (used by the Germans) has been the subject of much experimentation in the United States, but apparently

CARBURETTOR, INJECTION, Or — ?

without much success. Bendix-Stromberg also carried out a good deal of work in this direction. Investigation still goes forward, both in U.S.A. and this country, and nobody can foretell what developments may take place in the future.

(y) *Timed Injection into the Inlet Port or Manifold of Each Cylinder.*—Considerable work was carried out by the Bristol Aeroplane Co., Ltd., using a medium-supercharged Pegasus engine, and injecting the fuel into the elbow of the inlet manifold of each cylinder. According to Judge,* the rated altitude was lower than that produced by the standard engine, the reason doubtless being due to the loss of pressure ratio at the supercharger owing to the absence of fuel. This arrangement of timed manifold injection was also developed by the Marvel Carburettor Co. of America, and a number of aircraft so equipped were flown for some time. Another design, known as the Hasbrouck, was the object of much investigation by one of the great American aero engine concerns and did a good deal of flying, but never reached production.

While it is most likely that on small engines the orthodox carburettor will be retained for some years to come, it will be recalled that *Flight* has made previous mention of the system adopted on the Continental Series A engine of 50 h.p. This embraces timed injection into the manifold by plunger pumps, an arrangement developed in conjunction with the Fuel Injection Co. of Mich., U.S.A. On the whole, however, there appear to be no special advantages in timed manifold injection as against the other two types, and its future is a matter for conjecture.

(z) *Continuous Injection into the Supercharger Eye or Entry.*—This design is one which particularly engages our interest, since it has been developed in the United States concurrently with both arrangements described above, yet has outstripped them both and has now been in large-scale production for three years. (It is a product of the Stromberg Division of Bendix, and the unit is fitted to a large proportion of the American aircraft arriving in this country.)

It is hoped to publish a full description of the Bendix-Stromberg system in a subsequent article. In the meantime, its importance in the field of aeronautics warrants a few words upon its operation. In essentials, it consists of delivering a continuous (metered) spray of fuel, which is injected into the eye of the supercharger, or at any other selected position in the supercharger entry which is found by experiment to give the best fuel distribution. The pressure of the fuel at the nozzle is maintained constant and is of the order of 5 lb. per sq. in. The fuel is metered as in the conventional carburettor, and the airflow passes through venturi and throttle valves, *but no fuel passes through the latter*, since injection occurs separately on the engine side of the throttles.

Checking the characteristics of this arrangement against those in the table, it should possess the first five advantages of cylinder injection, for the following reasons:—

(1) No fuel passes the throttles.

(2) Carburettor and fuel line always full and under pressure (minimum 5 lb. per sq. in.).

(3) Same as (2).

(4) Ability to locate injector nozzle at any point which is found to give satisfactory fuel distribution.

(5) No fuel is taken through the airflow passage of the carburettor, so that carburettor loss is small for a given airflow. And since the fuel is injected between the carburettor and the blower, there is no loss of pressure ratio as in the case of cylinder injection.

While the fuel distribution of cylinder injection should theoretically be better than that of the conventional carburettor or any other form of fuel injection, it is yet to be proved whether this factor is reflected in actual consumption. The continuous spray system, however, while not possessing the theoretical claim of cylinder injection to good distribution, achieves this end very well by its ability to have injection nozzles of any required number or form located at any desired point in the supercharger entry.

On the other side of the scale, while none of the factors (a) to (h) in the table can be levelled against the system, it is indeed slightly heavier than the conventional carburettor and has more parts, and is slightly more costly. But in no case do these increases approach those of cylinder injection.

The fact that American aircraft engines are not fitted with boost controls has no connection with the design or operation of the injection system, but is merely due to the trend of design in American aviation circles. It is most probable that the influence of civilian flying is responsible for the absence of demand for boost control, and no American engines are so equipped, whether they are fitted with orthodox carburettors or the injection system.

What of the Future?

The battle of fuel injection versus conventional carburettor is thus seen to be a three-sided affair, with two entirely different forms of fuel injection already in the field, each backed by enormous production and service experience. However the battle may go, the war will doubtless prohibit any drastic changes of British policy, for while production and still more production is the cry, nothing that is not vital must clog the wheels. But if one may hazard a conjecture, it is that when post-war design has settled down after a period of peacetime research, all the larger engines, particularly those for aircraft-of-war, will be equipped with some form of carburation by injection, probably one of the two types outlined above, or developments of them. Smaller engines may retain the orthodox aero carburettor, which in its present state of development is an excellent instrument and up to the work demanded of it.

Yet who can tell? It may be that from the ashes of war some entirely fresh ideas will be born, and that in twenty years' time the petrol engine as we know it, as well as its accessory the carburation system, may have changed beyond anything within our present conception.

* A. W. Judge, *Aircraft Engines*, Chapman and Hall

SPITFIRES AND MOONSHINE

"DANGEROUS Moonlight" (Regal, Marble Arch) is a curious blending of fact and fiction. The R.A.F. supplies the fact, Hollywood the fiction. The two do not blend happily, for the contrast is too striking. Hollywood material actually goes more comfortably with pictures of air fighting deliberately faked in Hollywood itself, as in such films as "Hell's Angels." Then the cameraman naturally gets better opportunities, and his pictures show the same photographic quality as do the shots of love-making on the ground. Films taken in actual air combat are more real, but look less so.

The Hollywood part concerns a Pole (Anton Walbrook) who is a great musician and also a fighter pilot. He escapes from Warsaw to the United States and marries an American girl (Sally Gray). Then he hears of the Polish squadron being formed in England, but his wife tries to prevent his going to join it. The problem of conflicting duties is as old as fiction itself, and in this film it is presented in very ordinary fashion, supported by competent but hardly inspired acting. However, the great family of film fans will doubtless revel in all this, and possibly will feel their eyes grow moist and red.

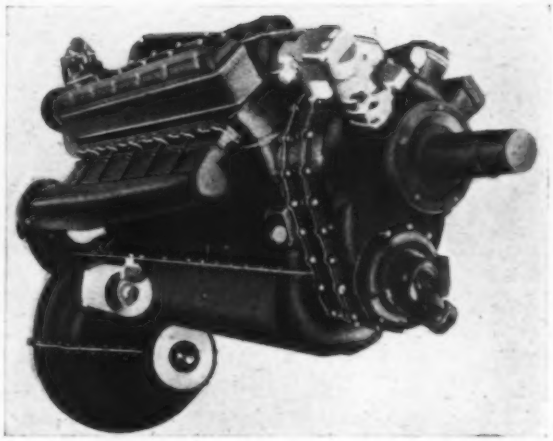
Ultimately the Pole joins the Spitfire squadron, and then comes the R.A.F. contribution to the story. Real fights are shown, and German machines are shot down. The take-off of the squadron in formation is a stirring sight, and we much enjoyed the slow roll by a single Spitfire after a victory. A really good insight into fighter methods of operation is given, and, to some spectators, this will be worth all the rest of the film put together. One wants to forget all about the Hollywood part, and wishes that echoes of it would not intrude into the mess scenes. However, it all ends happily.

All proceeds of the world première of the film last Thursday were devoted to the R.A.F. Benevolent Fund.

FORD AERO ENGINE

HERE is the "mock-up" of the projected Ford 12-cylinder aero engine mentioned previously in *Flight*. Outstanding features of it will be petrol injection, exhaust-driven turbo-supercharger, and the extensive use of castings instead of machined forgings to reduce the amount of machining. From an inspection of the exterior of the mock-up it is possible, with a reasonable amount of certainty, to make some deductions as to the design of the engine.

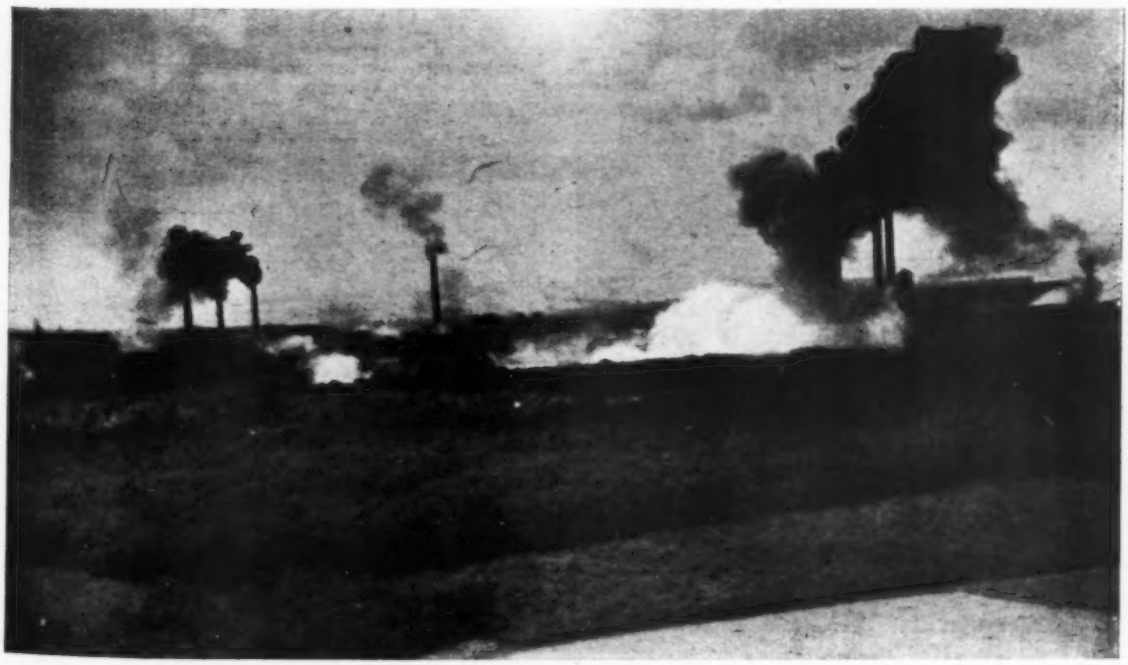
This 12-cylinder vee liquid-cooled engine has two exhaust and two inlet valves per cylinder directly operated from two overhead camshafts on each bank of cylinders. The valves are inclined to the axis of the cylinder and the cylinder heads are detachable. As the space in between the two banks is taken up by the large intake manifold, the injection nozzles are probably between the camshafts, though they cannot be seen. The cylinder block is a casting in light alloy, but whether the liners are of the "wet" or "dry" type cannot be determined. A circulating pump for the coolant is mounted on the front end and driven off the crankshaft. The coolant pipes are arranged along the outer sides of the two banks and probably between the banks on each side of the intake manifold. The bulky affair at the lower left is the exhaust-driven turbo-supercharger and the small starter-motor on the sump may possibly be for starting and accelerating the supercharger before the engine is started. The unit on the reduction gear casing may be either the governor unit for the constant-speed airscrew or the engine starter-motor. Large-diameter gears are used in the reduction gearing and the crankshaft is probably cast.



FORD BUT NOT FLIVVER: This is the mock-up of the projected Ford 12-cylinder aero engine. Some of the modern features of its design are petrol injection, exhaust-driven supercharging and the extensive use of castings instead of forgings.

"Supercharged" Ignition Harness

EVERY advance in flying exacts its price, a price which is paid not only in the lives of some of the pioneers but in increased engineering complexity. High-altitude flight is with us, but it is going to complicate the ignition system of the engine as the insulating property of the air decreases with the decrease of density at altitude. This makes ignition breakdowns more likely. Particularly is this so in the "shielded" ignition harness, of which the dead air spaces tend to become contaminated with various substances. These may be rain, oil, anticer fluid, or products from spark plug core leakage or electrical corona discharges and they tend to cause deterioration of the rubber insulation. The problem cannot be solved by the construction of airtight shielding, since the products are generated inside the shielding, so the other way is to blow a continuous stream of air through it. This can be done by maintaining a supercharge air pressure to the ignition harness and something like 5 lb. per sq. in. may be needed. Ventilation of the harness can thereby be assured and the harmful substances removed. Probably the Wright brothers did *not* foresee this development.



UNFORTUNATE FORTUNA: A general view of the daylight attack by Blenheims of the Bomber Command on the Fortuna power station at Cologne.

BOUND FOR BREST. A Fortress I takes off for the attack on the *Gneisenau* at Brest on July 24th.

HIGH-ALTITUDE DAY BOMBER

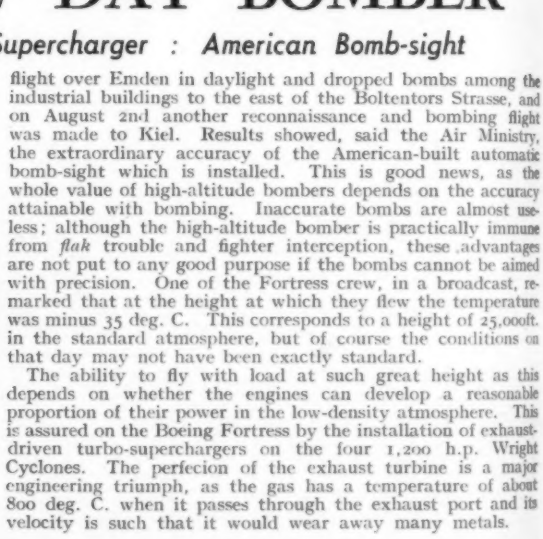
Boeing Fortress I : Exhaust Turbo-Supercharger : American Bomb-sight

ON July 24th, at two o'clock in the afternoon, "combat" bombs were dropped for the first time from Fortress aircraft of the Bomber Command—they were in action! The Fortresses were the spearhead of a fleet of bombers whose adventures we described in our issue of August 7th under the title of "The Great Daylight Attack." The photographs on this page show one of the Fortresses engaged.

Then, on July 26th, a Fortress I made a reconnaissance flight over Emden in daylight and dropped bombs among the industrial buildings to the east of the Boltentors Strasse, and on August 2nd another reconnaissance and bombing flight was made to Kiel. Results showed, said the Air Ministry, the extraordinary accuracy of the American-built automatic bomb-sight which is installed. This is good news, as the whole value of high-altitude bombers depends on the accuracy attainable with bombing. Inaccurate bombs are almost useless; although the high-altitude bomber is practically immune from *flak* trouble and fighter interception, these advantages are not put to any good purpose if the bombs cannot be aimed with precision. One of the Fortress crew, in a broadcast, remarked that at the height at which they flew the temperature was minus 35 deg. C. This corresponds to a height of 25,000ft. in the standard atmosphere, but of course the conditions on that day may not have been exactly standard.

The ability to fly with load at such great height as this depends on whether the engines can develop a reasonable proportion of their power in the low-density atmosphere. This is assured on the Boeing Fortress by the installation of exhaust-driven turbo-superchargers on the four 1,200 h.p. Wright Cyclones. The perfecion of the exhaust turbine is a major engineering triumph, as the gas has a temperature of about 800 deg. C. when it passes through the exhaust port and its velocity is such that it would wear away many metals.

AT THE MIGHTY WURLITZER. With four engines, feathering airscrews, retracting undercarriage, turbo-exhaust blowers and locking tail-wheel, the pilots have something to think about.



SIDE GUNNER. Though the Fortress armament cannot be said to be heavy, this is a formidable .5in. Browning machine gun. Readers will appreciate that this photograph is posed on the ground as gunners do not work at minus 35 deg. C. without flying suit or gloves.

THE ATFERO ACCIDENT

Great Britain, Canada, America and Australia Mourn Loss of Valuable Men

MYSTERY surrounds the causes of the flying accident which occurred on August 10th, and which cost the lives of 22 men engaged on the transatlantic air ferry service. The aircraft had taken off from the usual base, and at the point of departure nothing was known of its fate for twenty-four hours, when a farmer discovered the wreckage in hilly country. All the occupants had been killed by the impact, the aeroplane evidently having flown into the hillside. Eight of the victims were Canadian, seven came from the United States, six from Great Britain, and one was an Australian.

Three of the victims were pilots: Capts. E. R. B. White, F. D. Bradbrooke, and G. E. Price, the latter being an Australian. Four British radio operators, H. S. Green, H. D. Rees, G. H. Powell, and A. A. Oliver, lost their lives.

Capt. White joined the R.A.F. in 1921 as Boy Mechanic and left the service in December, 1930, with the rank of Sergeant Pilot. He joined Imperial Airways the following year, and in 1933 he was seconded as pilot to the Iraq Petroleum Company, which at that time were laying a 1,200 mile long oil pipe line from Haifa, in Palestine, to Kirkuk, Iraq. He was transferred to the European Division of Imperial Airways in 1935, and operated the London-Budapest route.

It may be remembered that in 1936 Capt. White established a record by flying the 2,970 miles from London to Brindisi, via Marseilles, and back to London in 18 hours. On the outbreak of the Cino-Japanese war in 1937 he piloted pressmen from Alexandria to Penang, one of the longest charter flights on record. In the same year Capt. White represented Imperial Airways in Berlin at the international conference on ice formation, a subject on which he was an authority. He was seconded to Atfero in the spring of this year and had flown something like one million miles. On the first Atlantic flight in 1940 he acted as navigator.

Canada shares with Great Britain the loss of Capt. F. D. Bradbrooke, who, although born in Worcestershire, has spent many years in Canada, where he learned to fly in 1928. Several years ago he came to this country to join the staff of *The Aeroplane*, of which he became assistant editor. He left that post to become editor of a little journal called *The Aero Pilot*. On its formation he joined the Air Transport Auxiliary and ferried aircraft from factories to service units, and finally he joined Atfero. He was a very experienced pilot.

Radio Officer H. S. Green served several years at sea and then transferred to Imperial Airways. For a considerable period he was stationed on the yacht *Imperia*, which Imperial Airways kept stationed off Crete. He returned to England last year and afterwards transferred to Atfero. Mr. Green was regarded by British Overseas Airways as one of the best radio operators in aviation.

To the relatives of these men, and of the others who perished, *Flight* offers its sincere sympathy.

'COPTERTROOPS

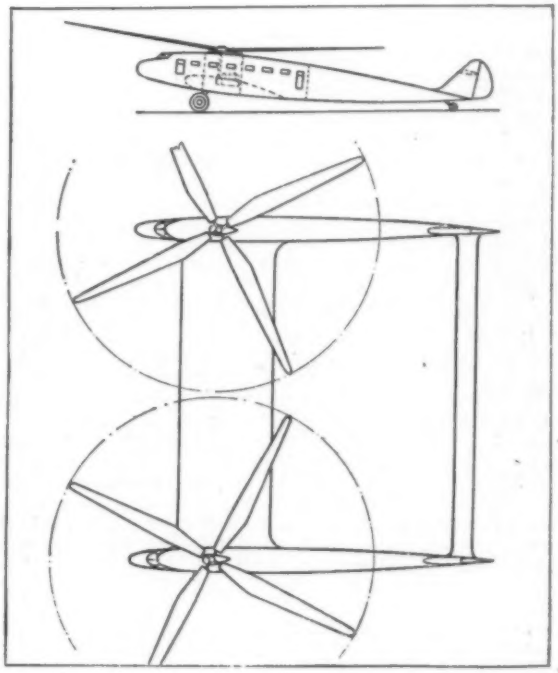
Is this the Next German Surprise?

RECENT performances of the Sikorsky helicopter in the United States led to enquiries regarding the Focke machine and speculation as to whether Germany would exploit its possibilities as a carrier for air-borne troops or parachutists. But no definite information on this point is at present available. That such a development was, however, visualised is shown by a German patent granted to Professor Dipl.-Ing. Heinrich Focke in 1938. No specific reference is made in the patent to military usage, but it would be too naïve to conclude, on that account, that the proposed machine was intended solely for commercial purposes.

It is admitted that the head resistance in forward flight of a machine having the rotors and their driving gears carried on open girder outriggers from a normal central fuselage is considerable and materially lowers the performance. The object of the invention is to avoid this additional drag. Accordingly, each rotor is mounted on a separate fuselage and provided with an independent power unit and transmission gear. The twin fuselages are arranged parallel, at a distance slightly in excess of the rotor diameter, and joined fore and aft by streamlined or aerofoil members. A retractable, single-wheel undercarriage is provided for each fuselage, but no particulars are given regarding what is, presumably, a single tail wheel.

As an alternative, the two fuselages may be constructed as flying boat hulls. Such a craft would have good transverse stability when on the water.

It would, of course, be necessary to synchronise the speed of the independently driven rotors and, within the scope of the patent, any suitable electric, hydraulic or mechanical means may be employed for this purpose.



Topics of the Day

BACK TO FRONT

A Word in Praise of Bold Experiments : Nature versus Mechanics : Doubts and Fears

ONE of the minor annoyances of a war is that one can no longer talk freely about interesting things to do with the design of aeroplanes, and one cannot, consequently, learn very much about what is happening to certain developments which were just beginning to be of real importance in the year before this carnagic affair started.

I've always had a bee in my bonnet about design. My idea is that, quite suddenly, someone will produce a thing which doesn't look like an aeroplane at all, but which goes very much faster and carries far more load than anything we can see at the moment. I have no facts or theories on which to base this strange assumption—it is merely an idea and probably the effect of wish-fulfilment. I want aeroplanes to be better and I see only years and years of really hard work before us when following present lines, so I immediately think in terms of miracles. Most people subconsciously carry the same idea over the war itself. The vistas of battle seem so appalling that one must believe in a miracle in order to carry on. Nobody really believes that the war will go on for another ten years; certainly nobody in Germany believes it—if they did they'd probably pack up to-morrow.

The Tail-first Scheme

Well, just before the war there *were* one or two quite exciting developments. The only one which can safely be mentioned at the moment was the *Canard* being built by the D.H. Technical School. It was very small and may still, for all I know, be sitting dustily and rather forlornly in a corner of a hangar, but the designers thought that it might do some very surprising things. Probably it did—but not quite giving the right form of surprise. I don't know, but that is the sort of thing. In a war it is hardly possible to continue with experiments of a really outlandish nature, because all efforts must be directed along channels of known productivity.

The wrongly-named tail-first type of machine has always intrigued me because it has seemed more sensible to my untutored brain to have the directing apparatus in front rather than behind where it is mixed up with all kinds of disturbances. The principles underlying mechanical things have long since prevented us from copying Nature, so I won't say anything about the fact that a great many birds steer as much with the front part as the back parts. Ornithopters have joined Pedrails and paddle steamers in the attic of wasted endeavour for the very good reason that the only propulsive effort possible with mechanical contrivances involves the principle of rotation rather than of oscillation. Incidentally, I don't guarantee accuracy in my examples. I may be thinking of Mr. Wells' Martian machines, and the Pedrail may have been a quite serious invention of the early nineteen-hundreds. I remember it vaguely as a series of mechanical hobnailed boots stumping along.

Engine-driven Joints

It is, in fact, no earthly use pointing to the Wonders of Nature (Amoebas to elephants) and saying that we ought to go and do likewise. Mechanical things are sufficiently complicated without the introduction of dozens of joints, each operated by its own private engine. But that doesn't mean to say that we can't put things back to front now and again and give it another try-out. We did it with the tricycle undercarriage, and I see no reason why we shouldn't do it with the wings as well. I suggest that the *Canard* is wrongly named because it isn't flying tail first: we've merely decided to make the mainplane the tail. By way of interjection, whoever saw a biplane bird?

[No one. But we have seen tandem monoplane insects.—ED.]

I confess that I find it difficult to visualise my new kind of revolutionary aeroplane. It is a very vague affair, dependent entirely on the brains of other people. But I comfort myself with the realisation that some very strange-looking aeroplanes go very quickly indeed, so perhaps a still stranger-looking one will go faster than ever. When, if ever, we reach the speed of sound, aeroplanes will certainly take on some weird outlines. Maybe it will be necessary to alter the shape in the air in order to reach such speeds. The thing will have to start off as a more or less conventional affair and before reaching seven-hundred-and-something miles an hour, the pilot will pull a large lever marked "EMERGENCY ONLY" and painted a bright red; at that moment the Spitfire shape will immediately change to one similar to that of a shell—sharp in front and round behind—while the wings will be re-formed to give the maximum amount of lift and the minimum amount of what is usually drag.

A Silly Story

The lever idea reminds me of the silly story of the young pilot in the lecture room who was asked what action he would take in the event of engine failure immediately after take-off. The young man thought for a moment and then remarked suavely that he would take a firm hold of the lever marked "EMERGENCY ONLY" and give it a smart pull. The words have always rather annoyed me; what emergency and when? And what would happen if the pilot forgot to pull my patent lever when the speed was being reduced below seven hundred miles an hour?

At the moment, and in this war, height rather than sheer speed appears to be the major requirement. Whatever they learn in this search for altitude (and the means of making the crew comfortable) should be useful when peace comes again, though I've never quite seen what all the stratosphere fuss was about or even why aeroplanes should be able to go particularly faster at prodigious heights. Since propulsion can only be obtained through action and reaction, what is gained on the roundabouts must be lost on the swings—at least so long as internal combustion engines are used. But then I've always been dense about exhaust-driven blowers; it seemed to me that you can only take out what is put in, and if the blower is going to do any effective blowing the back pressure will wreck the engine. It's like the inevitable invention of early childhood—an electric motor driving a locomotive which drives a dynamo which feeds the electric motor which drives the locomotive.

Perpetuum Mobile

. . . Once started it never stops. Not quite comparable, because for very good reasons it *is* possible to drive a blower and get more power. But that is another matter altogether. Just a question of helping the pistons to pull in as much mixture as possible in a ridiculously short space of time. Even with the help of a supercharger it has always amazed me that anything at all gets into a cylinder at high revolutions.

It's time somebody produced an entirely new prime mover. I.C. engines are altogether too complicated, though, with the help of the metallurgists, they are remarkably reliable. Perhaps someone will do so when there is a little more time to think about such things. "INDICATOR."

[Our amusing contributor has certainly covered a lot of ground this week; from tail-first aeroplanes to aircraft which change their shape in the air according to the speed, and from superchargers to new types of prime mover. In connection with the turbo-supercharger, "Indicator" seems to have fallen into the very common error of overlooking the fundamental fact that the petrol engine is only about 25 per cent. efficient, and that some 75 per cent. of the energy is wasted. The exhaust gases are a part of that waste, and the turbo merely recovers some of it.—ED.]

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters

ROCKET PROPULSION

Dr. Lanchester's Article Criticised

DR. LANCHESTER'S interesting article in the August 7th issue of *Flight* has ignored the most important attribute of the rocket—the fact that it works best in rarefied air or no air at all. It is therefore quite unfair to compare the range of a rocket with that of a fighter—a fundamentally different mechanism. The chief value of the rocket is its ability to give very high velocities and in infinite "ceiling."

Moreover, no one seriously considers the use of the simple powder fuels mentioned in Dr. Lanchester's article; liquid fuels, such as petrol-liquid oxygen, besides being readily controlled, contain far more energy. Much work has been done on mixtures of this type, particularly by the American Rocket Society, whose official publications contain the results of much research into motor and fuel efficiencies.

"AIRCRAFTMAN."

"No Future" Statement Challenged

I READ with interest the article published in the August 7th issue of your magazine by Dr. F. W. Lanchester.

Though I am not very conversant with the subject and I have not sufficient data to meet his argument, I cannot but disagree with his statement that "for the general purposes of propulsion, the rocket has no future." In fact, according to his own figures, the efficiency of the rocket and the propeller, are exactly the same. The whole difference is due to his considering in one case a "fuel" with 566,000 ft.-lb. per lb., and in the other petrol with 15,000,000 ft.-lb. per lb.

Unless flights outside the atmosphere are contemplated, there is no obvious reason why petrol should not be used in the rocket, air to burn it being available in unlimited supply. Of course, if this is done, the rocket is no longer a "self-contained" unit, and allowance must be made for the compression of the air, the rate of compression being variable with the altitude if constant output is wanted.

Now, if the efficiencies are comparable for a speed of 400 m.p.h., the rocket—with the same fuel—must be more efficient at higher speed. Indeed the propeller cannot function with high efficiency if the ratio between aircraft speed and tip speed is altered beyond certain limits, and the increase of speed entails crossing those limits, since the tip speed cannot be increased both for aerodynamical and mechanical reasons. On the other hand, when the speed of the aircraft increases, the compression of the air for the rocket is made easier by using the kinetic energy, and the efficiency should increase both for that and for the increase of $\frac{V}{v}$.

I should be delighted to receive further enlightenment on the subject if I am wrong, but I firmly believe that the rocket as a means of propulsion has a future.

"BELGIAN PILOT OFFICER."
(Formerly Lecturer at the University of Brussels).

DAIMLER-BENZ PATENT

Similar to Earlier British Engine

I READ with interest your article, "Another Engine Layout," in your edition of the 31st ult., and note that Daimler-Benz have patented this layout.

May I point out that the late Mr. J. G. Parry Thomas patented this layout in 1915 or 1916, and at that time made most of the claims for it that Daimler-Benz claim for it to-day?

The engine was an eight-cylinder—6in. bore, 6in. stroke—and was estimated to give about 450 h.p. The cylinders were in pairs at 90 deg. to each other, like a Maltese Cross. It had one master rod and three articulated rods to each crankpin, which were in the same phase to eliminate the rocking couple along its length.

I was engaged on the design of this engine in 1916-17, and later assisted in the testing of a single-cylinder version with Mr. Reid Railton. I remember its maximum speed was around 6,000 r.p.m.

Incidentally, it had several novel features, including laminated valve springs and eccentric drive to the overhead camshaft. These features were later incorporated in the Leyland straight Eight car.

The weight of the complete engine was around 1½ lb. per b.h.p.—a remarkable figure for a normally aspirated engine in those days.

The close of the last war in 1918 put an end to further developments of this type of engine, and little further was ever heard of it.

F. SUMNER, A.M.I.Mech.E.

ASYMMETRICAL AIRCRAFT

Actual Example Seen in Germany

I NOTE with interest your article in the issue of August 7th, "Asymmetrical Aircraft," and am interested insomuch as, whilst at Hamburg on an official flight some four to six weeks before the outbreak of hostilities between this country and Germany, I saw on the aerodrome a Blohm and Voss Offset Fighter. As far as my recollections go, the engine (radial) was set to the left and the pilot's "office" was in the centre of the machine.

I have often wondered what progress has been made with this type of fighter. Having heard nothing further from that day to this, I felt the matter might be of interest to you, as the actual aircraft has been designed and flown.

J. VIVIAN HOLMAN.

"BRAD"

A Personal Tribute

TO say only that aeronautical journalism had lost one of its most important figures in the Atfero accident would be very much understating the case. Capt. F. D. Bradbrooke was much more than an aeronautical journalist. He was one of those amateur pilots who had helped to *make* private flying in this country, and was, at the same time, an "amateur technician" of no mean importance. He had a finger in every pie remotely connected with his primary interest and hobby, and was by way of being a humorist in his own inimitable way.

"Brad" was one of the most enthusiastic persons anyone could possibly meet, and his enthusiasm was catching. As a member of the staff of *The Aeroplane* he was an unstinting supporter of everything which he felt to be a "good thing," and a somewhat vitriolic opponent of anything which he felt to be useless or silly. When, for instance, the tricycle undercarriage was considered merely as a peculiar kind of throwback, "Brad" was vigorous in his praise, and I was with him when he flew the first tricycle type to appear in this country. The machine in question was a "safety-first" type, and until "Brad" started to expatiate (with his usual lack of professional "tightness") I had been interested only in the slots and things with which the machine was fitted.

It was Bradbrooke, in fact, who helped to make this country "tricycle conscious." And that was only one of the many ideas which he had sponsored. What was more important is that he was prepared to put his enthusiasm into vigorous practice. In the course of his investigations he would fly almost anything anywhere. And I must say that in his search for truth (of the aeronautical kind) he risked his neck in one or two very queer contraptions so that he could at least give the designer an absolutely fair opinion—in print or otherwise.

At the beginning of this war he was one of the founders of Air Transport Auxiliary, and here again his enthusiasm was terrific.

Later, when the Atlantic ferrying business started, he was one of the first to volunteer for the work, and was thereafter—until he started on the work itself—to be seen, so to speak, with a sextant in one hand and a textbook on astronomical navigation in the other. At odd moments he would hoist the sextant to his eye and compute his position—though he knew perfectly well that he was.

When there is peace and civil flying returns we shall miss "Brad" a very great deal. All this war-flying was only for him an interlude preparatory to returning to his greatest interest—civil flying. The only kind of flying which is really worth anything in the long run. Yes, we shall certainly miss him.

"INDICATOR."

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements

Awards

THE KING has been graciously pleased to approve the following awards:—

DISTINGUISHED SERVICE ORDER.

Flt. Lt. H. BURTON.

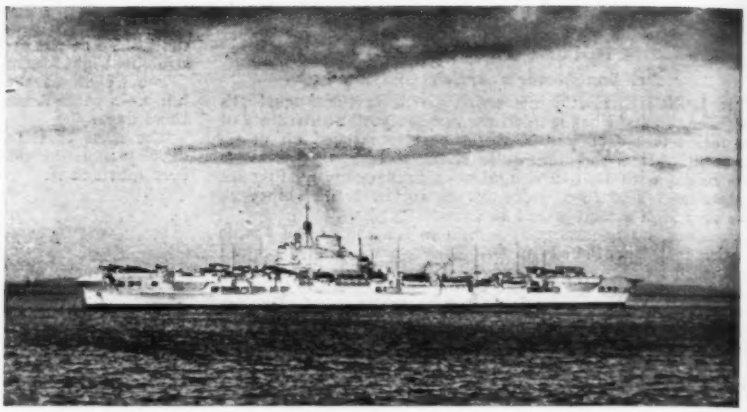
Wing Cdr. C. H. APPLETON, D.F.C. No. 604 Squadron.—This officer has commanded the squadron since February, 1941, and by his sound organisation, drive, energy, and high skill in flying has enabled it to attain a splendid record in night fighting. Whilst under his inspiring leadership, the squadron has destroyed at least 45 enemy aircraft at night and damaged many others. He has personally destroyed two and damaged two enemy aircraft.

Wing Cdr. J. R. A. PEEL, D.F.C.—Since March, 1941, this officer has led his wing over France on twenty-eight occasions, and under his leadership it has destroyed thirty-two enemy aircraft. In April, 1941, he led a formation of aircraft on a successful low-flying machine-gun attack against Berck, and damaged or destroyed three Messerschmitt 109's. One afternoon in July, 1941, he was shot down off the French coast, but, despite this experience, he led the wing the next morning. The success of the wing in escorting our bombers and destroying enemy aircraft has been due to Wing Cdr. Peel's training and leadership.

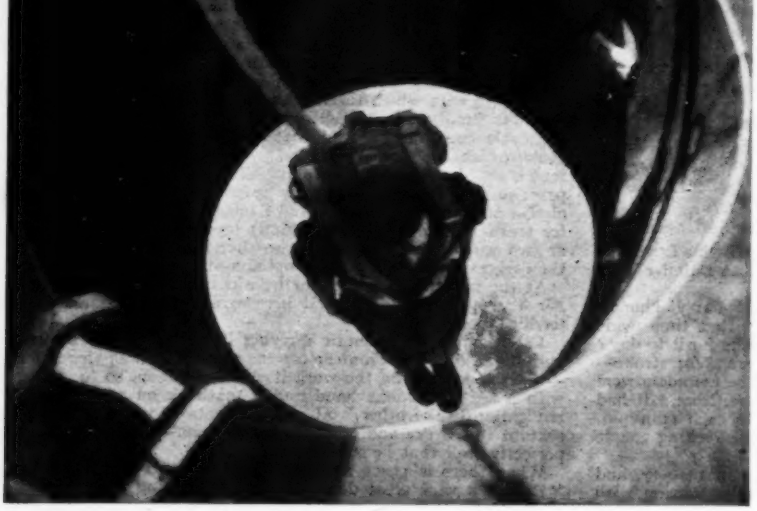
Sqn. Ldr. M. L. ROBINSON, D.F.C. No. 609 Squadron.—This officer has commanded the squadron since October, 1940. He has acted as leader in recent offensive operations over occupied territory, and, on numerous occasions, has led his wing with determination, skill and courage. The successes obtained reflect the greatest credit on the leadership and devotion to duty of this officer. He has destroyed at least fourteen enemy aircraft and damaged others.

Act. Wing Cdr. P. F. WEBSTER, D.F.C., No 21 Sqn.—In July, 1941, this officer led a formation of aircraft which carried out a low-level attack on the docks at Rotterdam. By extremely accurate navigation and the excellent tactics employed by Wing Cdr. Webster, the formation was enabled to carry out a highly successful attack. Shipping was bombed from mast height with the utmost determination, and seventeen large ships totalling some 90,000 tons were destroyed, whilst others totalling about 40,000 tons were damaged. The brilliant leadership, courage and skill of this officer contributed very materially to the magnificent success of the operation. Since the beginning of June, 1941, Wing Cdr. Webster has participated in six operational missions, each of which has been an unqualified success.

Act. Flt Lt. G. G. DAVIES, R.A.F.V.R., No. 102 Sqn.—One night in July, 1941, this officer was the captain of an aircraft which carried out an attack on Bremen. Over the target area the aircraft was subjected to heavy anti-aircraft fire whilst held in the beams of a concentration of searchlights. Nevertheless, Flt. Lt. Davies continued his bombing run and was shortly engaged by enemy fighters. In the course of the action the rear gunner was killed and much damage inflicted to the aircraft, causing it to go out of control at 10,500 feet. In spite of great difficulties, Flt. Lt. Davies, showing exceptional skill and admirable presence of mind, succeeded in regaining control after the aircraft had fallen some 7,000 feet. Coming out of the spin the aircraft was again attacked by enemy fighters, but Flt. Lt. Davies skilfully maintained a level flight and with a superlative display of airmanship succeeded in flying back to an aerodrome in this country, where he landed safely without further damage to the aircraft or injury to his crew. Throughout the whole of this most hazardous operation Flt. Lt. Davies displayed the utmost courage and determination and was certainly responsible for saving the aircraft and the crew from destruction.



ANOTHER FLOATING AERODROME: The first photograph of our new aircraft carrier H.M.S. *Formidable*. It will be remembered that she was first mentioned in connection with the battle of Cap Matapan.



THUMBS DOWN THE SEAMS OF THE TROUSERS: A paratroop, holding himself stiffly erect, makes a practice jump from a captive balloon. Note the static line of webbing and the balloon winch lorry on the ground.

BAR TO THE DISTINGUISHED FLYING CROSS.

Act. Sqn. Ldr. P. S. TURNER, D.F.C. No. 145 Squadron.—This officer has led his squadron on all sweeps over France, and has set a splendid example by his quiet coolness in the face of the enemy. He has been responsible for the destruction of at least twelve enemy aircraft.

Act. Wing Cdr. E. N. RYDER, D.F.C., R.A.F.O., No. 56.—This officer has been on operations continually since the outbreak of war and has shown extraordinary powers of endurance. He has set a splendid example by his leadership and determination and has destroyed at least five and damaged other enemy aircraft.

Wing Cdr. A. McD. BOWMAN, D.F.C., No. 39 Sqn.—This officer has commanded the squadron since April, 1941, during which period it has carried out a large number of long-distance reconnaissances. By his leadership, skill and determination, Wing. Cdr. Bowman has contributed largely to the great successes achieved.

Act. Sqn. Ldr. P. G. WYKEHAM-BARNES, D.F.C., No. 73 Sqn.—This officer has been almost continuously engaged on active operations in the Western Desert since the war with Italy began. Since assuming command of the squadron he has displayed outstanding leadership and determination and has contributed in a large measure to its high standard of efficiency and fighting spirit.

Flt. Lt. P. H. M. RICHEY, D.F.C., No. 609 Sqn. —This officer has displayed great skill and coolness throughout the numerous operational missions in which he has participated and has destroyed at least nine enemy aircraft and damaged a further seven. As a flight commander he has invariably displayed a high sense of responsibility for the safety of his fellow pilots.

DISTINGUISHED FLYING CROSS.

Wing Cdr. D. F. W. ATCHERLEY, No. 25.—This officer has carried out a large amount of operational flying at night, sometimes under adverse weather conditions. The efficiency of his squadron and the success it has had is due to Wing Cdr. Acherley's drive, energy and leadership. He has destroyed three enemy aircraft at night.

Act. Wing Cdr. T. N. PARTRIDGE, No. 18 Sqn. (missing).—In July, 1941, this officer participated in an attack against enemy shipping at Le Havre. By his skilful leadership the formation was enabled to carry out an attack from a low level. In spite

SERVICE AVIATION

of accurate anti-aircraft opposition the operation was carried through with great determination and resulted in a loss to the enemy of some 18,000 tons of shipping with a further 4,500 tons damaged. Wing Cdr. Partridge scored direct hits on the largest ship in the outer harbour. By his careful preparation for the flight and his determined and courageous leadership throughout, Wing Cdr. Partridge contributed materially to the successes obtained.

Act. Sqn. Ldr. K. C. FORSYTHE, No. 110 Sqn.—In July, 1941, this officer participated in an attack on an enemy convoy consisting of five merchant ships with five escorting destroyers. As a result, one merchant ship of 7,000 tons, with ammunition on board, blew up, and another 6,000-ton ship was so severely damaged that, about an hour later, only the stern was above water. A third ship was also so badly hit that the speed of the convoy was reduced in consequence. This enabled Swordfish aircraft to complete the destruction of the disabled vessel and also to destroy another one. By his splendid leadership and skill, Sqn. Ldr. Forsythe contributed materially to the brilliant success of this operation.

Act. Sqn. Ldr. W. W. STRAIGHT, M.C., A.A.F., No. 242 Sqn. (missing).—This officer has participated in many engagements against the enemy throughout which he has displayed excellent qualities of leadership and zeal. He has destroyed at least three enemy aircraft, one of which he shot down at night.

Flt. Lt. A. J. M. SMYTH, No. 55 Sqn.—This officer has taken part in over fifty operational missions over enemy and enemy-occupied territory. He has led the squadron on many occasions and has at all times displayed the greatest keenness and determination, setting an excellent example to all.

Act. Flt. Lt. A. B. BROADLEY, R.A.F.V.R., No. 105 Sqn.—One evening in July, 1941, this officer participated in a raid against shipping at Rotterdam. The attack was carried out from mast height and Flt. Lt. Broadley succeeded in obtaining direct hits on an 8,000-ton ship, apparently under construction and nearing completion, in one of the harbour docks. Flt. Lt. Broadley has participated in twenty-two operational missions and throughout has displayed great skill and courage.

Act. Flt. Lt. C. H. MCFIE, A.A.F., No. 616 Sqn. (missing).—This flight commander has carried out many operational sweeps over enemy territory. He has at all times displayed efficiency and qualities of leadership which have proved of great value. He has destroyed two and damaged a further three of the enemy's aircraft.

P/O. G. S. E. MORRIS, R.A.F.V.R., No. 70 Sqn.—This officer was rear gunner of an aircraft which was attacked from the rear with cannon and machine-gun fire from three enemy fighters while making a run over Nasrulla aerodrome. The enemy's first burst of fire destroyed the hydraulic system of the rear turret and wounded P/O. Morris in the abdomen and right leg. Despite his wounds, he operated his turret by hand and fired a long burst into one of the attacking fighters, which burst into flames and crashed. The remaining attackers concentrated on the rear turret, which was shot to pieces. P/O. Morris, however, continued to keep his guns in action and fired another long burst of fire which, with one from the front gunner, entered another of the enemy fighters and caused it to dive towards the ground. It was probably destroyed. Further bursts from the front and rear guns were fired into the remaining fighter causing it to break off the engagement. Throughout the action P/O. Morris set a splendid example of courage and endurance.

Flt. Lt. E. S. Lock, D.S.O., D.F.C. and Bar—one of our foremost fighter pilots—who is posted as missing. W/Cdr. Bader, who was shot down at the same time, is a prisoner of war.

P/O. W. J. REES, R.A.F.V.R., No. 75 (N.Z.) Sqn.—One night in July P/O. Rees and Sgt. Lewis were the captain and wireless operator respectively of an aircraft which attacked a target at Duisburg. Although the aircraft was hit by anti-aircraft fire, P/O. Rees persisted in his attack and completed a successful run over the target. On the return journey, whilst over the Ruhr, the aircraft was held in the beams of a large searchlight belt and subjected to an attack by an enemy fighter which inflicted severe damage. The second pilot was killed and two other members of the crew dangerously wounded, while Sgt. Lewis was badly shocked and rendered temporarily deaf when a cannon shell exploded close to him. Nevertheless, realising that his captain was without aid and could not leave the controls, Sgt. Lewis tended his wounded comrades, afterwards collecting the navigator's log and maps and assisting him in setting out the courses. P/O. Rees, with exceptional skill, finally overcame all navigational difficulties and, helped by Sgt. Lewis, who had repaired his wireless set and obtained bearings, flew back to this country where a safe landing was made. P/O. Rees displayed outstanding courage and determination in extremely harassing circumstances and was ably assisted by Sgt. Lewis, who showed great fortitude and initiative. Both have participated in numerous operational missions.

DISTINGUISHED FLYING MEDAL.

Sgt. I. W. LEWIS, No. 75 (N.Z.) Sqn.—For citation see P/O. Rees, D.F.C., above.

Sgt. Genge Edward BESSELL, with effect from Jan. 8, 1941.

Sgt. Oliver Barton JAMES, A.F.V.R., with effect from March 20, 1941.

Sgt. R. J. C. GRANT, R.N.Z.A.F., No. 145 Sqn.—This pilot has taken part in twenty-two operations over enemy territory during which he has destroyed two enemy aircraft and damaged several others. His keenness and devotion to duty have set an excellent example.

Sgt. J. A. HUGHES-REES, R.A.F.V.R., No. 609 Sqn.—This airman has completed a large number of operational sorties against the enemy and has destroyed at least four of their aircraft. In every engagement he has shown courage and enterprise.

Sgt. R. D. MOHR, R.A.A.F., No. 39 Sqn.—This airman was the observer of an aircraft which carried out a long-distance reconnaissance over enemy territory. In the course of the flight the pilot became incapacitated and fell over the controls. The aircraft went into a dive and Sgt. Mohr, with great coolness and initiative, fitted the auxiliary control and succeeded in regaining control of the aircraft after it had lost height for some 4,000 feet. He then flew safely back to base before handing the controls over to his pilot, who had recovered sufficiently to land the aircraft safely. By his initiative and promptitude, Sgt. Mohr saved the aircraft and crew from becoming a loss.

Sgt. A. G. PALMER, R.A.F.V.R., No. 609 Sqn.—This airman has taken part in eighty-eight operational sorties. He has at all times shown tenacity and great devotion to duty and has destroyed one of the enemy's aircraft.

Amendments.

In notifn. of July 1 regarding Sgt. L. R. James, *for* No. 22 Sqn. *read* No. 201 Sqn.

In notifn. of July 25 regarding Sqn. Ldr. E. G. Jones, D.F.C., *for* No. 50 Sqn. *read* No. 80 Sqn.

THE KING has also been graciously pleased to give orders for the name of the following airman to be published in the London Gazette as having received an expression of Commendation for brave conduct in connection with Civil Defence:—

A/C.1 Reginald Victor HUBBARD

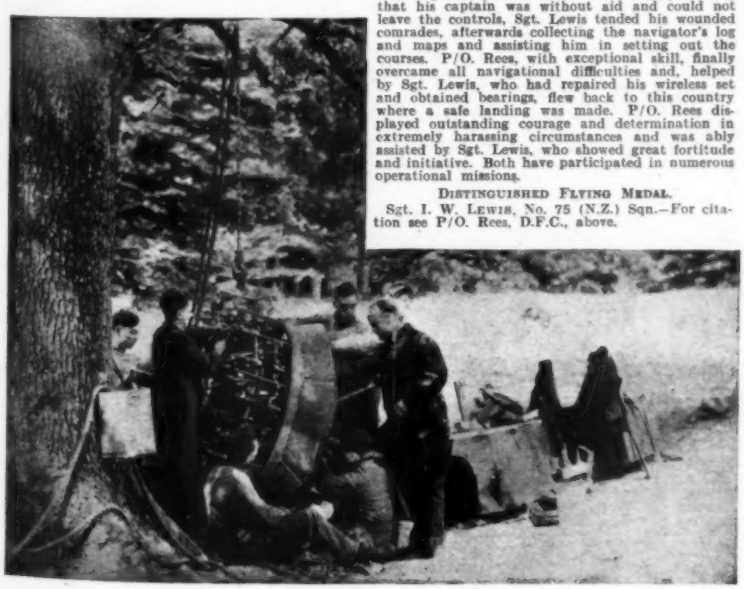
Roll of Honour

Air Ministry Casualty Communique No. 77.

THE Air Ministry regrets to announce the following casualties on various dates. The next-of-kin have been informed.

KILLED IN ACTION (WHILE FLYING IN OPERATIONS AGAINST THE ENEMY).—Sgt. G. A. Alcock; Sgt. W. F. Archer; P/O. H. Blackall; Flt. Sgt. D. Brett; P/O. H. L. Cousins; Sgt. N. A. F. Folkard; Sgt. R. E. Gale; Sgt. P. Gibbins; P/O. A. Grout; Sgt. W. A. Hannah; Sgt. H. W. Hardie; Sgt. R. E. Hibbert; Sgt. R. D. Hull; Sgt. S. W. Jackson; Sgt. S. D. Lane; Sgt. C. M. S. Lewis; Sgt. S. R. Rishworth; Sgt. J. M. Smith; Flt. Sgt. J. Stewart; Sgt. N. Stockdale; Sgt. C. M. Sumner; Sgt. G. A. Todd; Sgt. R. E. G. Williams.

PREVIOUSLY REPORTED MISSING BELIEVED KILLED IN ACTION NOW PRESUMED KILLED IN ACTION.—Sgt. W. Bell; Sqn. Ldr. C. E. E. Florigny; Sgt. E. G. Hayward; A/C.1 W. F. Hubbard; Sgt. E. R. Pitts; Sgt. H. F. Trescothic.



UNDER THE GREENWOOD TREE: Ground crews do a little engine maintenance in pleasant, if unusual, surroundings.

SERVICE AVIATION

PREVIOUSLY REPORTED MISSING NOW PRESUMED KILLED IN ACTION.—Sgt. P. J. Anstey; Flt. Lt. M. R Baillon; Act. Sqn. Ldr. R. C. Beaman; Sgt. J. Beattie; Sgt. C. Bourne; F/O. J. T. Burgess, Sgt. G. E. Bygrave; Sgt. J. E Campbell; Flt. Lt. H. D. Card; Sgt. S. Crocombe; Sgt. A. G. B. Crouch; Sgt. P. O'N. Darbishire; Sgt. F. Eddowes; Sgt. A. R. Fox; Flt. Lt. W. E. Gore, D.F.C.; P/O. J. H. Gow; Sgt. T. Gray; Sgt. W. A. Griffin; Sgt. B. F. R. Hubbard; Sgt. J. C. Hulbert; Sgt. J. F. Huxtable; Sgt. J. H. Jeffries; F/O. R. H. A. Lee, D.S.O., D.F.C.; P/O. A. P. Linsdell; Sgt. C. G. McCarthy; F/O. W. L. McKnight, D.F.C.; Sgt. A. I. G. McLean; Flt. Sgt. D. W. Mathews; Sgt. W. B. Miflin; Sgt. T. M. Moore; P/O. R. L. Pattle; Sgt. F. Pease; F/O. C. D. Peel; P/O. R. H Rigby; Sgt. P. Rowe; Sgt. P. A. Sobey; Sgt. R. B. Stilwell; Sgt. K. H. Wake; Sgt. R. W. Willis; Sgt. E. F. Wilson; Sgt. W. K. Winterbottom; P/O. N Wylam-Walker; P/O. C. R. Wylie.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. D. V. Davis; Sgt. L. E. Stalder; Sgt. G. C. D. Stowe; F/O. J. W. J. Taylor; Sgt. H. Trenholm.

WOUNDED OR INJURED IN ACTION.—Sgt. L. Coen; Sgt. L. C. Gilding; P/O. R. C. Gosling; Sgt. C. F. James; Sgt. H. Lawson; Sgt. G. Moss; Sgt. W. D. Perriment; P/O. P. J. Pound; Sgt. J. B. Seymour; Sgt. J. H. Smith; Sgt. R. D. Telling; Sgt. L. J. Ware.

MISSING BELIEVED KILLED IN ACTION.—Sgt. H. T. M. Ainscough; P/O. C. McC. Bateman; Sgt. K. C. J. Botsford; Sgt. R. C. Brutey; Sgt. K. W. M. Christopher; Sgt. J. Diggory; Sgt. D. N. Dulley; Sgt. D. A. Dupree; P/O. L. T. Glover; Sgt. M. Guest; Flt. Sgt. P. Hudson, D.F.M.; Sgt. R. W. Jenkins; Sgt. E. A. R. Leavers, D.F.M.; Sgt. A. Macpherson; W/O. S. J. Magee; Sgt. M. T. Mathews; Sgt. C. T. C. Mercer; Sgt. J. C. Newlands; Sgt. J. R. Park; Sgt. D. G. Patterson; Sgt. E. W. Perkins; Sgt. J. W. H. Phelps; Sgt. S. C. Retter; P/O. H. G. Reynolds; Sgt. A. E. Routley; Sgt. R. C. Smith; Sgt. R. T. Stephens; Flt. Sgt. R. S. Storie; Sgt. H. Tait; Sgt. W. J. Tidey; Sgt. P. A. Truman; P/O. F. W. Turner; F/O. K. G. Webb; Sgt. J. H. Wilson; P/O. R. S. Wilson; Sgt. F. Woodruff; Sgt. J. Woodward; Sgt. J. Wright.

MISSING.—Sgt. A. W. Adams; Act. Sqn. Ldr. L. Aitken; Sgt. W. Allison; Sgt. L. H. Anderson; P/O. P. B. Ashby; Sgt. L. E. Badland; Act. Flt. Lt. R. A. Bailey; P/O. J. Bailie; P/O. M. R. F. Baker; Sgt. A. R. Batch; P/O. G. H. Batchelor; A/C.1 L. W. Bayley; Sgt. J. W. Bent; Sgt. K. G. Betts; Sgt. J. E. S. Bevan; Sgt. J. H. Bevans; Sgt. F. W. Black; Sgt. H. Black; P/O. R. V. C. Bolster; Sgt. M. H. S. Bolton; P/O. T. E. Bolton; Sgt. W. R. Bradford; Sgt. R. Brearley; Sgt. C. W. D. Brown; Sgt. J. H. Brown; Sgt. A. E. Brownbill; Sgt. J. Bruckshaw; Sgt. J. S. Burnside; Sgt. L. Byrne; Sgt. A. R. Cain; P/O. A. W. Camp; Flt. Sgt. A. J. Cannell; Sgt. A. S. Carson; Sgt. A. R. Carvell; Sgt. A. J. Casey; Sgt. J. A. Causon; Sgt. L. N. Chappell; Sgt. H. G. Chorlton; Sgt. J. Clayton; Sgt. P. B. N. Cleburne; Sgt. L. D. Coogan; Sgt. K. E Corrie; Sgt. F. G. Coulby; Sgt. R. F. Culley; Sgt. W. B. Cundill; Sgt. J. R. Dale; P/O. R. W. Dawson; P/O. P. Delorme; Sgt. W. J. Dossetter; Sgt. G. G. Duckers; Sgt. A. Eaves; Sgt. F. Elliott; Sgt. G. F. Entwistle; Sgt. W. Everest; Cpl. J. H. Fleming; Sgt. M. Ford; F/O. D. N. Forde; Sgt. T. G. Freeman; P/O. R. B. Galt; Sgt. E. G. Gibbs; Sqn. Ldr. E. P. P. Gibbs; Sgt. D. F. Gibson; Sgt. E. W. Gimson, D.F.M.; Flt. Lt. W. B. Goddard, D.F.C.; Sgt. J. C. Goodwin; Sgt. W. E. Grainger; Sgt. R. S. Green; Sgt. D. W. Griffiths; Sgt. J. Hall; Sgt. J. B. Hancock; Sgt. B. P. Hanson; Sgt. N. W. Harding; Sgt. G. M. Hardy; Sgt. F. A. Harmer; Sgt. W. M. Harris; Sgt. C. L. Harrison; Act. F/O. V. R. Hartwright, D.F.M.; Sgt. H. Hastings; Sgt. R. E. Haycock; Sgt. H. R. Heighton; Act. Flt. Lt. H. C. Hilton; Sgt. W. L. Hiscock; Sgt. J. Hughes; Sgt. J. Humphries; Sgt. K. Huntley; Sgt. E. R. Ingram; Sgt. W. J. Jackman; Sgt. H. Jones; Sgt. K. I. Jones; Sgt. W. Kelly; P/O. T. F. Kennan; P/O. R. E. Kerr; Sgt. G. Kilburn; Sgt. K. A. King; Sgt. G. K. Kircher, Sgt. A. H. Knape; Sgt. A. Kossick; Sgt. R. F. Lewis; Sgt. S Linky; Sgt. G H. Livingstone; Sgt. R. H. Lomas-Smith; P/O. G. F. Lowes; Sgt. O. R. Lucas; Sgt W. H McDougall; Sgt. J. K. McFarlane; Sgt. W. A. MacKillop; Sgt. P. J. McLean; Sgt. K. G. MacLeay; Sgt. S. W. R. Mabbett; Sgt. R. K. Main; F/O. E. S. Marrs, D.F.C.; Sgt. W. G. Marsh; Sgt. H. E. Meadows; Sgt. A. Melville; Sgt. W. W. Melville; Sgt. J. T. Melvin; P/O. J. T. Monks; Sgt. R. Morgan; P/O. R. D. Morley; Sgt. S. C. Morse; Sgt. J. A. A. Morton; P/O. F. M. Moss; P/O. H. H. Mountain; Sgt F. B. Mulford; Sgt. L. R. Mynott; Sgt. E. G. Nethercott; Sgt. J. Newhouse; Sgt. B. K. Nicholls; Sgt. K. Noddle; Sgt. H. Nykerk; Sgt. R. W. Owen; Sgt. G. Owens; P/O. H. M. Owens; F/O. H. Oxlin; Sgt. C. F. J. Parslow; Sgt. R. S. Peck; A/C.2 J. Perkins; Flt. Lt. C. R. McL. Petley; Act. Wing-Cdr. L. V. E. Petley; Sgt. R. Plume; Flt. Sgt. D. H. G. Poole, D.F.M.; F/O. A. L. Pullen; Flt. Sgt. A. G. Reading; Sgt. P. T. Relf; Sgt. R. J. Reynolds; Sgt. R. O. Rintoul; Act. Flt. Lt. T. G. F. Ritchie; Sgt. W. Ross; Sgt. F. B. Rowley; P/O. W. G. Rowse; Flt. Sgt. D. E Russell; P/O. A. W. Ryan; Act. Sqn. Ldr. D. H Seale; P/O. G. H. Seeley; Sgt. D. Sills; P/O. R. M. Slade; Sgt. G. E. Smith; Sgt. H. Smith; Sgt. S. Sparkes; Sgt. R. Spencer; P/O. C. MacK Stickney; P/O. A. F. Struthers; F/O. M. F. Suckling; Sgt. J. Sykes; Sgt. F. G. Taylor; Sgt. R. H. Thompson; Sgt. C. G. Todd; Sgt. D. H. Todd; P/O. M. D. Tucker; Sgt. J. M. B. Tunnah; Sgt. E. D. Tyler; Sgt. J. A. Tyrrell; Sgt. S. Vardy; Sgt. R. Waddington; Sgt. D. P. Walker; A/C.1 J. Wallace; Sgt. J. F. Walton; P/O. A. K. Watson; Sgt. A. Webster; P/O. R. B. Webster; Sgt. W. R. Welch; P/O. G. G. Whitting; Sgt. L. A. W. Wilkinson; Sgt. A. N. Williams; Sgt. W. G. Williams; Sgt. S. W. Winter; Sgt. R. F. G. Witherington; Sgt. E. Wood; Flt. Sgt. G. T. Wood; Sgt. R. Wordsworth; Sgt. H. K. V. Wyatt; P/O. W. H. Zillessen.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE (WHILE ENGAGED ON NON-OPERATIONAL FLYING DUTIES OR ON THE GROUND THROUGH ENEMY ACTION.—Sgt. D. S. Birtwhistle; Flt. Sgt. R. McCormack, D.F.M.; Flt. Lt. D. L. Rayment, A.F.C.; Sgt. R. Sadler; Sgt. G. H. Vickers; L.A/C. W. Weatherburn.

KILLED ON ACTIVE SERVICE.—P/O. A. W. Amos; Sgt. W. H. K. Annetts; P/O. D. A. Attewell; Sgt. D. E. B. Augustus; Sgt. G. Balmforth; Sgt. L. C. Botterman; P/O. J. N. Bowker; Sgt. A. F. Brookes; L.A/C. J. R. Brumpton; Sgt. A. Bush; L.A/C. L. J. Chambers; Flt. Sgt. G. W. Chilmaid; Sgt. R. A. C. Connell; Sgt. G. T. Corbett; L.A/C. J. F. Corke; L.A/C. J. Crompton; Flt. Sgt. R. G. Crossman; A/C.1 G. Davies; Sgt. I. F. Dell; Sgt. J. Evans; Sgt. G. Farbrother; Sgt. T. Ford; L.A/C. P. E. Freeman; A/C.1 E. F. Hawker; Flt. Lt. B. G. Haylock; L.A/C. P. A. Healey; Sgt. A. Hill; Sgt. R. G. Howe; Act. Flt. Lt. P. J. Lea; Act. Flt. Lt. D. U. Lowson, D.F.C.; P/O N. McCarthy; Sgt. P. McEwan; Sgt. B. K. Madgwick; P/O. M. W. Major; F/O. S. C. Mounsey; Sgt. F. A. Nelson; A/C.1 J. Oliver; W/O. R. S. Pryke; Act. F/O. A. A. Purkiss-Ginn; Sgt. J. W. Rowe; A/C.2 S. Rowley; L.A/C. C. E. Sackley; P/O. A. E. Sinclair; Sgt. J. G. Smithson; P/O. P. B. G. Spary; Sgt. L. M. Taylor; P/O. D W. Thompson; L.A/C. C. R. Watkins; Sgt. H. W. White; L.A/C. A. C. Whiting; L.A/C. J. K. M. Windrum.

PREVIOUSLY REPORTED MISSING BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.—Sgt. W. G. Eliott; P/O. H. F. Perrott.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. C. J. E. Butler; Cpl. C. H W. B. Cox; L.A/C. C. G. Draper; A/C.1 A. E. E. Foster; L.A/C. R. G. W. H. Giles; L.A/C. F. F. Grebby; Sgt. C. Kirkby; A/C.1 C. Ormiston; Sgt. J. McI. Thompson.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—A/C.2 K. R. Bennett; A/C.2 J. D. Bruce; A/C.1 R. Gray; L.A/C. W. Holl.

PREVIOUSLY REPORTED WOUNDED OR INJURED ON ACTIVE SERVICE, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sqn. Ldr. C. J. F. Kydd, D.S.O., D.F.C.; Sgt. J. A. Pollock.

DIED ON ACTIVE SERVICE.—Cpl. H. Bennett; A/C.2 S. Bole; A/C.1 E. A. Boothby; A/C.2 W. J. Crudge; W/O. W. Doe; A/C.2 M. D. Dornsaft; A/C.1 W. S. Elsmore; L.A/C. A. J. Girling; A/C.1 H. J. Glover; A/C.2 R. G. Hibbins; A/C.2 C. L. Hoare; Act. F/O. G. L. Holloway; A/C.1 J. Howard; A/C.2 D. W. Kates; A/C.1 P. P. Lechane; A/C.2 M. Morrison; A/C.1 R. W. Pett; A/C.2 H. M. Richards; L.A/C. H. W. Selman; Cpl. F. W. Smith; L.A/C. S. H. Smith; L.A/C. L. F. Surridge; L.A/C. J. C. Taylor; Flt. Lt. L. S. Tindall; L.A/C. R. F. K. Turner; Act. Flt. Lt. F. Watkinson; A/C.2 M. Williams.

PREVIOUSLY REPORTED MISSING BELIEVED KILLED IN ACTION, NOW REPORTED PRISONER OF WAR.—P/O. G. Godden.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sqn. Ldr. H. D. H. Cooper, D.F.C.; F/O. H. A. R. Prowse; Sgt. R. J. Thorburn.

Air Vice-Marshal R. E. Saul, C.B., D.F.C., who commands a fighter group, talking to one of his station commanders.

Women's Auxiliary Air Force

DIED ON ACTIVE SERVICE.—A/CW.1 E. Brown.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. A. G. Costello; Sgt. R. A. McAllister; Sgt. H. C. Thompson.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sqn. Ldr. A. N. Hick; F/O. R. B. Scutts.

MISSING BELIEVED KILLED IN ACTION.—P/O. D. N. R. Armstrong; Sgt. L. G. Overheu.

MISSING.—P/O. W. J. Greening; Sgt. J. F. James; Act. F/O. J. Kinnane; Sgt. O. W. McLean; Sgt. R. J. B. Rost.

KILLED ON ACTIVE SERVICE.—P/O. A. S. Middleton.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. F. S. Houston; Sgt. T. Manning; Sgt. J. A. Maville; Sgt. J. S. Warren.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. L. S. Hill.

WOUNDED OR INJURED IN ACTION.—Sgt. F. L. English.

MISSING BELIEVED KILLED IN ACTION.—Sgt. J. E. Drew.

MISSING.—P/O H. D. Brander; P/O. L. S. Christman; Sgt. C. S. Edwards; Sgt. G. S. Edwards; P/O. J. G. Elliott; Sgt. J. N. Hallam; Sgt. J. N. Kirk; Sgt. M. Livis; Sgt. C. MacK. Martin; P/O. R. G Mitchell; Sgt. R. A. Reid; Sgt. J. H. Roberts; Sgt. W. A. Strachan; Sgt. G. C. Waldern.

MISSING BELIEVED KILLED ON ACTIVE SERVICE.—P/O. R. B. Campbell; Sgt. L. G. Cowing; Sgt. J. A. Proctor.

KILLED ON ACTIVE SERVICE.—Sgt. T. L. Kirk; P/O J. K. Roberts; Sgt. K. L. Shonk; Sgt. F. L. Turner; Sgt. F. J. Venn; Sgt. G. P. Whicher; Sgt. D. R. White.

WOUNDED OR INJURED ON ACTIVE SERVICE.—P/O. W. E. Merryfield.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—P/O. H. J. Cooper.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. J. Bracegirdle

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. T. C. M. Browne; Sgt. J. C. Cornish; Sgt. C. H. Douglas.

MISSING BELIEVED KILLED IN ACTION.—Sgt. F. S. Haslemore.

MISSING.—Sgt. R. H. Hartstone; P/O. D. J. Jamieson; Sgt. W. G. Jesson; P/O. A. D. McMurtrie; Sgt. O. A. Matthews; Sgt. J. R. Nation; Sgt. L. L. Reid; Sgt. R. W. Taylor.

South African Air Force

KILLED IN ACTION.—Flt. Lt. A. J. Both.; 2/Lt. Cronine.

KILLED ON ACTIVE SERVICE.—Lt. E. H Curran; Lt. E. A. Todd.